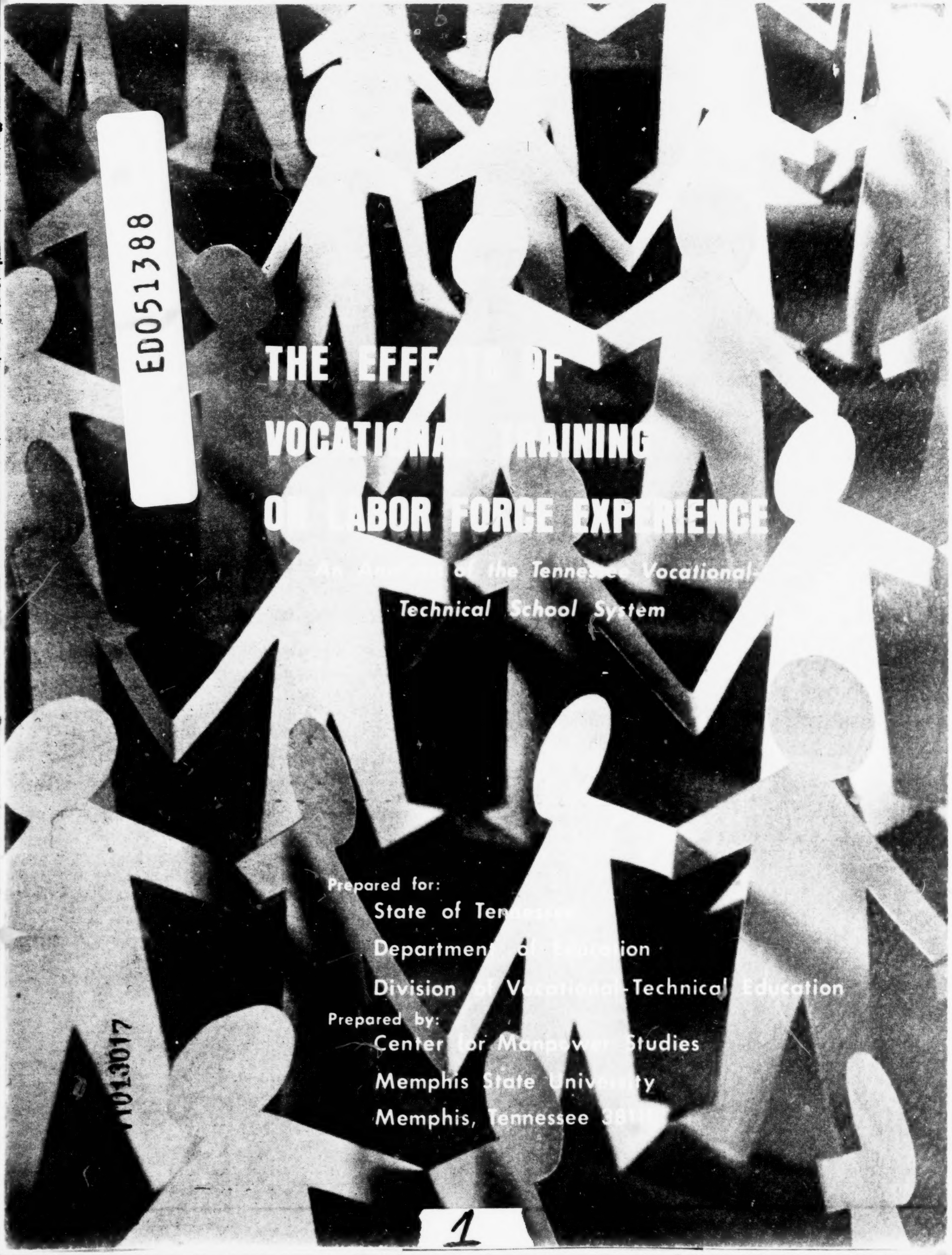
DOCUMENT RESUME

ED 051 388 VT 013 017

AUTHOR	Schriver, William R.; Bowlby, Roger L.
TITLE	The Effects of Vocational Training on Labor Force Experience. An Analysis of the Tennessee Area Vocational Technical School System.
INSTITUTION	Memphis State Univ., Tenn. Center for Manpower Studies.
SPONS AGENCY	Tennessee State Dept. of Education, Nashville.
PUB DATE	Feb 71
NOTE	149p.
AVAILABLE FROM	Vocational Curriculum Laboratory, Box 1114, Murfreesboro, Tennessee 37130
EDRS PRICE	EDRS Price MF-$0.65 HC-$6.58
DESCRIPTORS	*Area Vocational Schools, *Cost Effectiveness, *Followup Studies, Job Placement, Program Costs, Program Evaluation, Statistical Analysis, Statistical Data, Student Costs, Student Employment, Student Placement, *Vocational Education

ABSTRACT

To analyze the differential benefits from vocational training, a study was made involving 1,701 former students selected at random from 19 area vocational-technical schools in Tennessee. Major objectives of the study were to determine: (1) economic justification of vocational training, (2) wage differences among the vocationally trained and non-trained, and (3) internal rates of return to area vocational-technical schools. The data collected from high school records and responses of students to a mail questionnaire were put in tabular form for analysis. Some of the findings included: (1) Vocational training increased labor force participation, reduced unemployment, and increased occupational mobility, (2) Students with the lowest educational ability received the greatest rate of return, (3) Vocational training was beneficial regardless of educational attainment, and (4) Total public rate of return on investments in vocational training was 6.3 percent while the private rate of return was 13.4 percent. An example of a data form, questionnaire, followup letters, followup cards and records of the public cost of Tennessee Area Vocational-Technical School Program are appended. (AS)



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THE EFFECTS OF VOCATIONAL TRAINING ON LABOR FORCE EXPERIENCE

An Analysis of the Tennessee Vocational-Technical School System

Prepared for:
State of Tennessee
Department of Education
Division of Vocational-Technical Education
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VT013017

ERRATA

p. vi	The first sentence should read, "The authors wish to express. . ."
p. 96	The inequality should be $0 < \frac{dy}{dx} < \propto$.
p. 103	Equation 3 should have a plus sign between the two right-hand terms.
p. 104	Equation 4 should have an equal sign between the two members.
p. 110	Footnote 47 should read, "See Footnote 43."

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THE EFFECTS OF VOCATIONAL TRAINING ON LABOR FORCE EXPERIENCE

An Analysis of the Tennessee Area Vocational Technical School System

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February 1971

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ACKNOWLEDGMENT

The authors with to express their gratitude to Charlie M. Dunn, Assistant Commissioner for Vocational-Technical Education, and Edward C. Merrill, former dean of the College of Education at the University of Tennessee, who jointly sponsored the original research project upon which this report is based. The study was possible only with the close cooperation of Ben Hirst, Director of Area Vocational-Technical Schools, and the counselors at the local area schools who performed heroically at the formidable task of data collection.

We also wish to express our gratitude to our own able staff, particularly F.M.H. Murtaugh and Jerome Taylor, *bon vivants*. We wish to thank Robert A. Bohm, University of Tennessee, for his technical assistance.

R. L. Bowlby
W. R. Schriver

PREFACE

In June of 1968 the Tennessee Division of Vocational-Technical Education asked the authors to conduct a study of benefits conferred on their former students as a result of vocational training received in the system of Tennessee Area Vocational-Technical Schools (AVTS). The initial study was funded jointly by the division of Vocational-Technical Education and the University of Tennessee, College of Education.

The study proceeded through June of 1970, and this monograph reports upon the data collected and the analysis performed during that period. Subsequent to the termination of the initial study period, the United States Office of Education awarded the authors a grant (OEG-4-70-0053) to analyze further the data (generated in the initial study) with regard to: (a) estimation of the effect of certain program and student characteristics on the private and social internal rate of return; (b) estimation of the effect of these same characteristics on the income of former AVTS students; (c) determination of the effect of vocational education on the income-education distribution. These three topics, although discussed in this monograph, are treated in detail in our report to the United States Office of Education entitled An Analysis of Differential Benefits from Vocational Training.

Although our initial objective was to estimate the costs of and returns to the AVTS system during the period under study (1963 through 1967), the route was somewhat circuitous. In order to make the final determinations, it became necessary to collect and analyze many small bits and pieces of information about the students and the programs in which they studied. This monograph reports upon the various subtopics that were necessary steps for our ultimate computations. It is the mutual conclusion of the staff of the Tennessee Division of Vocational-Technical Education and the authors that a comprehensive report on the data, the method of selection and collection, the preliminary findings based upon reported wage rates rather than Social Security Earnings, and the lateral subtopics treated at several junctures in the study would all be extremely useful to other investigators embarking on similar or related ventures. Then, too, the treatment of the minutae included here may assist the reader in understanding the assumptions in our other published reports on this study.

Since the following chapters are somewhat unrelated to each other in terms of continuity, a brief overview of each chapter may help keep the reader afloat. Chapter I, The Economic Justifications of Vocational Training, presents the theoretical case for investments in vocational training as an effective tool in raising the income level of a region. Also outlined in this chapter are the general topics investigated in the study.

Chapter II, Review of the Literature, traces the historical development of the concept of human capital and presents reviews of recent applications of this concept to measurement of the benefits of investments in vocational training.

Chapter III, The Study Population, contains a description of the sample procedure, data collection, and characteristics of the sample.

Chapter IV, Analysis of Wage Differences Among the Vocationally Trained and Non-Trained, contains the analysis of the wage data reported by the respondents in the questionnaire. This chapter also includes a summary of differences in labor force participation, unemployment, and occupational mobility among the two groups.

Chapter V, Internal Analysis of Income (Social Security Earnings) Among the Vocationally Trained, contains the analysis of differences in earnings among various categories of former AVTS students based upon student characteristics and instructional program characteristics. A parallel statistical analysis of these differences was subsequently made and is presented in our previously cited report to the United States Office of Education.

Chapter VI, Internal Rates of Return to AVTS Training, contains a brief description of our method of computing the internal rate of return and our findings. A more complete treatment of this topic can also be found in the report to the Office of Education.

SUMMARY OF FINDINGS

1. From analysis of wage data reported by respondents, AVTS training resulted in average direct benefits of $1.57 per week (primary effect only).

2. From analysis of wage data reported by respondents, AVTS training resulted in average direct and indirect benefits of $7.02 per week (primary and secondary effect).

3. From analysis of wage data reported by respondents, wage benefits of AVTS training were maximized among those former students who were male, who migrated, and who received substantial hours of instruction in machine shop, welding, or electricity-electronics.

4. Other direct effects of AVTS training were increased labor force participation, reduced unemployment, and increased occupational mobility.[1]

5. The cost of AVTS instruction during the period studied was $1.52 per hour.

6. The total rate of return on investments in AVTS training during the period studied was estimated to be 6.3 percent; the private rate of return was estimated to be 13.4 percent.

7. Former students with the lowest educational ability received the greatest rate of return from AVTS training based upon analysis of Social Security earnings.[2]

8. AVTS training was beneficial to former students regardless of prior educational attainment. The income of grade school dropouts, grade school graduates, high school dropouts, and high school graduates tended to be increased in constant ratio.[3]

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[1] Roger L. Bowlby and William R. Schriver, "Nonwage Benefits of Vocational Training: Employability and Mobility," *Industrial and Labor Relations Review*, Vol. 23, No. 4 (July 1970).

[2] Roger L. Bowlby and William R. Schriver, *An Analysis of Differential Benefits from Vocational Training*, Report to the United States Office of Education, Grant No. OEG-4-70-0053, January 31, 1971.

[3] Ibid.

Chapter I

THE ECONOMIC JUSTIFICATIONS OF VOCATIONAL TRAINING

The Tennessee Situation

During the past decade, Tennessee has been faced with three serious social problems: out-migration of its people, high unemployment rates in many regions, and a low per capita income. Partly as a result of its ties with the national economy and partly through its own efforts, Tennessee has improved its position significantly in recent years.

Employment

Tennessee has improved its unemployment position relative to that of the nation. From 1957 through 1963 the Tennessee unemployment rate was higher than the national average in every year, but since 1963[1] it has been at about the same level as the national average. Although Tennessee contained pockets of high unemployment (both in social strata and geographic area), the transition from the traditional employment of the past–farm, forest, and mine--to manufacturing and other production sectors has been accomplished in much of the state, particularly in the metropolitan and adjacent areas, with few traces of structural unemployment remaining. However, there are many isolated areas where the lack of productive employment opportunities leads directly to high unemployment rates in the area, and indirectly to higher unemployment rates in the areas to which the usual out-migration occurs, since migrants from undeveloped areas seldom possess marketable skills. Unemployment persists in certain areas of the state, particularly the mountain and plateau counties of East Tennessee, and a rather large group of rural counties in central West Tennessee.

Migration

Recent population figures indicate that the out-migration trend in Tennessee is slowing and that the trend may reverse itself. Between 1950 and 1960, Tennessee's population increased by only 8.4 percent, while that of the nation increased by 18.5 percent, indicating heavy out-migration.[2] In the same period, only 36 Tennessee counties gained in population.[3] Since 1960 the gap has narrowed between the growth rates in Tennessee and the Nation, and the state rate is presently approaching the national rate of approximately 1.5 percent per annum. It is estimated that only 13 counties in Tennessee lost population between 1960 and 1968.[4] Public and private training and employment opportunities have been important factors in stemming the tide of out-migration.

Income

The case of personal income in Tennessee is neither so favorable nor optimistic in outlook. If per capita income in Tennessee is compared with that of the Nation from 1950 to the present, Tennessee falls well below the national average and is improving its position more slowly than the other states in its census region.[5] In 1960, per capita income in Tennessee was 69.2 percent of national per capita income ($1,859 compared to $2,566); in 1967, per capita income in Tennessee was 75.5 percent of national per capita income ($2,369 compared to $3,137).[6]

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[1] Manpower Report of the President, Tables A-1 and D-4.

[2] Census of Population, 1950 and 1960.

[3] County and City Data Book, 1962.

[4] Ormond C. Corry, "Population Estimates for Tennessee Counties," Tennessee Survey of Business (March 1969), p. 3.

Therein lies the crux of the problem. Tennessee's growth in employment and population compares favorably with that of the Nation, yet the gap in personal income is closing at an agonizingly slow pace. In terms of nonagricultural employment, manufacturing, wholesale and retail trade, and services continue to dominate the Tennessee economy, both absolutely and in rate of growth as employment sectors and as sources of income. Manufacturing appears to be the primary source of income generation for the Tennessee economy, i.e., the economic base. Therefore, any attempt to raise income significantly in Tennessee must concern itself with increasing the efficiency of the factors of production in the manufacturing sector, particularly labor payments.

If we accept the economic assumption that wages increase as the efficiency of labor increases, we are introduced to the proposition that investments in manpower training can generate additional income in excess of the original investment. This concept has its roots in the thinking of the classical economists (particularly the writings of Adam Smith and David Ricardo).[7] These early economic thinkers were aware that the productivity of a labor force could be increased by increasing the skill base within the labor force, creating additional income to be shared by all society.

The position of advocating vocational training investments as a method of raising per capita income is akin to the physical concept of investing in new machinery in order to increase output. In the context of the former, investments in training are termed "human capital." The concept is defined as follows by the Department of Economic Affairs of the United Nations:

> It is obvious, however, that future production may be facilitated not only by net additions to a country's stock of conventional capital goods, but also by education, on-the-job training, human migration, acquired knowledge, improvements in health and living standards, and many intangibles that affect labor productivity. Recognizing the omission of these intangibles in the production process, the Department asserts that "depending on the purpose for which the statistics (of capital) are to be used, the range of items included in capital formation . . . may vary from a narrow one, as for example physical plant and equipment, to one which includes also current expenditures for research, health, and education which improve technology and increase the productivity of the labor force." Hence, these qualitative changes in the labor force represent the application of capital to labor; the resulting resource, a hybrid of labor and capital, is often called "human capital." Since the acquisition and maintenance of both conventional and human capital involve real costs as well as promises of future returns, there is some symmetry between the concepts.[8]

Today much emphasis is being placed upon upgrading the nation's labor force through investments in "human capital." Expenditures on vocational education, rather than being conceived as social consumption on behalf of the recipients, are termed capital investments in that the monies create a "stock of productive goods" that are expected to return in later accounting periods an amount of money far in excess of the cost of the original investment. The effects of investments in human capital on the American economy are enormous. It has been estimated that investments in human capital in the United States during the interval 1929-1957 may have contributed a full 20 percent of the Nation's economic growth as measured by changes in the Gross National Product.[9]

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[5] William R. Schriver, "Industrialization of the Southeast," American Journal of Economics and Sociology (January 1971), Table 2.

[6] Ibid.

[7] Hans E. Jensen, "Non-Economic Factors in Economic Growth," Tennessee Survey of Business, (February 1967).

[8] Quoted by B. F. Kiker, The Concept of Human Capital, Bureau of Business and Economic Research, University of South Carolina, No. 14 (November 1966), p. 1.

Training investments administered through the Tennessee State Department of Vocational Education alone from fiscal year 1960 through fiscal 1967 amounted to $80,865,120.15. During the last three years of that period, investments averaged $16,494,239.92, culminating in expenditures during fiscal 1967 of $18,910,851.77 (including $766,000 Appalachian funds). Enrollment in 1966-1967 was 124,688, with 2,066 teachers instructing in the following areas: agriculture, distributive education, health occupations, home economics, office occupations, technical, and trade and industry.[10] This was in addition to training provided by private vocational schools and industry.

The state vocational training is administered through high schools, Manpower Development Training Act programs, junior colleges, and technical institutes, and area vocational-technical schools, the latter three being partially provided for by the Vocational Education Act of 1963.

Commonly held assumptions, supported by various studies, indicate that youths and adults receiving vocational education are rewarded with the "good life" in terms of more favorable employment experiences. Higher incomes, better job security and satisfaction, and geographic and occupational mobility have all been posited as being positively related to vocational training. Then, too, there is some evidence that vocational training centers may attract industrial development. In any case, investment in vocational training in a region can lead to increased personal income in that region.

Unfortunately, upon more rigorous examination, the relationship between vocational training and favorable employment experiences may be less direct and dependable. That is, there are many qualifying conditions that relate to the overall effectiveness of vocational training, particularly with regard to benefits to the state or region within which it occurs. To be most effective, vocational training must be related to the economy of the region. The output of vocational training programs should be related in kind and quantity to the employment demands of the efficient economic activities of the region. Consideration should also be given to skill flexibility to allow for interoccupational mobility, and to skill demand in employment centers outside the region (particularly in the case of high labor surplus areas) to allow for geographic mobility. A vocational training program which provides training output to inefficient economic activities, i.e., less than average wage jobs, is of doubtful value, for it does little to raise personal income and merely shifts the training burden from the employer to the public.

There is no evidence that the Tennessee vocational training output has not been related to the employment demands of the economy. On the contrary, the State Department of Vocational Education has attempted to coordinate its training output with employers both formally and informally. This has been especially true of the system of area vocational-technical schools, where a primary duty of each school superintendent has been to establish a cooperative relationship with the area employers. However, there has been no formal method of feedback to the vocational education system in the state to determine output efficiency. It would seem desirable, particularly in light of the magnitude of vocational education expenditures, to compare the effects of the various training programs on the recipients' employment experiences, utilizing the results as a regulatory feedback to the vocational training system.

The philosophical proposition that education is beneficial to students can be accepted without serious question, but it is an "unscientific" statement in that it cannot be proved or disproved, and it is too vague to provide guidance to those entrusted with making policy decisions such as the introduction of new types of programs, the abandonment of old ones, or changes in emphasis among existing programs. The general approach of this research project was to accept the proposition that "education is good for you" as a working hypothesis, then sharpen the proposition by making it more specific. As the proposition became more specific, it was subjected to tests as scientific as it was possible to devise. Whether it has passed or failed these tests, the results have implications usable as guidelines by makers of educational policy, and the authors have attempted to make these implications as clear and specific as possible.

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[9] Edward F. Denison, The Sources of Economic Growth in the United States and the Alternatives Before Us (New York: Committee for Economic Development, 1962).

[10] Tennessee Division of Vocational-Technical Education, Annual Reports.

As a first simplification, the general proposition that education is beneficial will be narrowed to the more specific proposition that it is beneficial in economic terms, i.e., that education pays off in dollars and cents. This has the advantage that dollars and cents are measurable, and so a statistical test of the hypothesis becomes possible. It has the disadvantages that it could lead to the acceptance of a faulty hypothesis (if economic advantages are offset by non-economic disadvantages), or the rejection of a valid hypothesis (if non-economic advantages are present notwithstanding the absence of economic advantages). In some areas such an approach may even be rejected entirely as an improper intrusion of materialistic values into what should be a humanistic system; one can imagine, for example, the administrators of a divinity school who quite properly are not concerned with the dollar incomes of their graduates.

The economic simplification will be adopted as being reasonably well suited to vocational schools. This should not be interpreted as a judgment that non-material values have no place in vocational education, but only as a judgment that they are unlikely to be both greater in importance and opposite in direction from the monetary ones. It can be assumed, then, that economic advice is welcome even if it is not the only advice which is weighed before action is taken.

The second simplification is to narrow the focus from education in general to vocational education in Tennessee's area vocational-technical schools. Aside from limits on the time and money available for this research, which militate against a more ambitious project, there is a scientific reason for preferring to examine a relatively small and homogeneous group of institutions, for averages may submerge significant aspects of the truth.

The proposition tested in the present research may be stated as follows: "Education received at Tennessee Area Vocational Schools is beneficial to recipients in economic terms." The test consisted of discovering the post-graduation experience of former students and comparing it to the best possible guess as to what this experience would have been in the absence of any postsecondary training.

The Position of Vocational Education

Basic to the American educational tradition is the assumption that education is beneficial to all recipients. This implied premise may be valid in the "consumption" sense but it is subject to legitimate challenge in the "investment" sense.

By the "consumption" sense is meant the value of education resulting from increases in appreciation of life from the academic and liberal arts point of view. The individual consumes this good much as he does other less abstract goods. By "investment" sense is meant the value of education as a source of earning income characterized by education in professional, occupational, or vocational schools.

Clearly, it may not be assumed that liberal arts and purely academic education as contrasted to professional or occupational education, such as engineering or business, are mutually exclusive. Elements of consumption and investment benefits accrue to each type of education but in lesser and greater predictable amounts. That is to say, an educational plan designed to increase the quality of life and responsibilities of citizenship, independent of income or productivity considerations, would necessarily concentrate on consumptive education, while an educational plan designed primarily to increase productivity and income would logically concentrate on investment education.

No implication is intended that the evaluative criterion of consumptive education is exclusively within the domain of aesthetics, nor of economics in the case of investment education. A liberal arts education may enhance one's economic well-being just as occupational education may add to one's aesthetic quality of life. Also, there are major occupations for which societies provide training that may not be justifiable in terms of an economic investment, e.g., a minister, a nuclear bomber pilot, etc; and there are subpopulations for which society provides occupational training that may not (and perhaps should not) be economically justifiable, e.g., physically and mentally handicapped groups, the aged, etc.

The above notwithstanding, an educational planner, assuming the rational consideration of available alternatives, must possess knowledge crucial to the relationship between "investment" education and economic returns. Granted that there are other rational systems for evaluating occupational education, the economic understanding remains necessary, if insufficient within itself. It is, therefore, the central objective of this investigation to provide a clearer understanding of the effects of occupational education, particularly with regard to long-term effects, in order that "present values" might be more conclusively stated.

There exists a well developed body of literature dealing with the subject of economic returns to occupational training, generally termed "human capital" studies. Despite increasing knowledge in this area, certain theoretical and methodological problems remain largely unexplained. A major area of difficulty has centered around the problem of experimental design, specifically the matching of an experimental study population with a control group of cohorts similar in all measurable respects except the receipt of occupational training. This procedure must be followed in order to avoid "capitalizing" extraneous variables such as intelligence, motivation, social class position, etc. Recent studies have resolved many of the difficulties, but a major hiatus remains in estimating the time length of the positive effects of occupational training. Although a positive relationship between occupational training and income improvement (net above what would have been expected without occupational training) is well documented and supported in the literature; the duration of the training effect over time has not been decisively determined. This is a crucial point, for it is impossible to measure accurately the rate of return on investments in human capital without knowing the net income from the training effect accruing to the recipient over his working life and *not merely the short-term period immediately following training.* Then, too, the effects of vocational education on nongraduates and graduates of high school, rural and urban populations, and young *versus* old persons are unclear.

The results of this study will offer insights into the basic causal relationship between the independent variable, occupational training, and the dependent variable, earned income. This relationship will be rigorously examined by comparing a group of workers with from one to six years experience in the labor force subsequent to occupational training with a closely matched cohort group similar in all measurable respects except occupational training.

The Study

An attempt was made to ascertain the employment experiences of a random sample of former students at Tennessee Area Vocational-Technical Schools. The following relationships were examined in various combinations:

income, unemployment rate, occupational mobility, industry of employment, and geographic mobility	*versus*	program of study, hours of instruction, sex, race, urban-rural, I.Q., prior formal education, and relatedness of training to job

In addition to a statistical analysis of the above relationships, an attempt was made to measure two types of effects of vocational training upon earned income: (a) primary effects and (b) secondary effects. The measurement of the primary effects involved a comparison of earnings of former Area Vocational-Technical School (AVTS) students with matched cohorts, neither having received any formal training or education beyond high school excepting the AVTS training received by the experimental subjects. Thus, any earnings differentials could be directly attributed to AVTS training *ceteris paribus*.

Measurement of the secondary effects entailed the above comparisons plus additional comparisons of former AVTS students who received other formal training or education subsequent to AVTS training with their matched cohorts who may have received additional training or education beyond high school, rejecting only those cohorts who were not participating in the labor force or who received a baccalaureate degree. These earnings differentials would be attributable to AVTS training plus the sequential advantages or disadvantages subsequent to training as compared to their cohorts with regard to additional training programs and education.

An adjunctive measurement of the "opportunity costs" of AVTS training was also made. This was accomplished by comparing the earnings of AVTS students *during training* with the earnings of their cohorts at that time, assuming that the AVTS students could have been earning the average amount their cohorts earned had the former not been attending AVTS. Thus, the hypothesized earnings disadvantage of the AVTS students would consist of the opportunity cost of earned income foregone in order to receive training. The students' opportunity cost plus the school system cost (social cost) comprise the total costs to be amortized over the expected working life of the student at the amount of his earnings advantage over his cohort, assumed here to be positive.

Objectives

1. To provide the public (with particular reference to policy makers and legislative bodies) with a demonstration of the effects of vocational training.
2. To provide administrators and educators, particularly those responsible for planning and the allocation of funds, with a specification of relationships among alternative training investments and employment experiences.
3. To provide immediate evaluation of the effectiveness of the various training programs and to provide an ongoing method for continued evaluation of future training programs.
4. To provide relevant and timely information useful in student guidance and counseling.

Chapter II

REVIEW OF THE LITERATURE

The Concept of Human Capital

First, let us examine the concept of human capital and its development, since with increasing frequency economists are rejecting the time-honored triad of land, labor, and capital. Often this classification of resources is too ambiguous for quantitative research. In particular, the distinction between labor and capital is often found to be unsatisfactory. In an attempt to find a solution to this problem, many economists are now utilizing the concept of "human capital" to explain the investment and returns to skills in the labor force.

This is not to say that the idea of investment in human beings is new. B. F. Kiker points out that many of the ideas that are a part of the human capital concept of today had been put forward as early as Sir William Petty.[11] Essentially, the classicists found it difficult to explain the differences in the wages of skilled vs. unskilled workers. Hans Jensen shows that Adam Smith was aware of the problem of "acquired skills":

> (Included among the growth promoting factors are) the acquired and useful abilities of all the inhabitants...of society. The acquisition of such talents, by the maintenance of the acquirer during his education, study or apprenticeship, always costs a real expense, which is a capital fixed and realized, as it were, in his person. These talents, as they make a part of this fortune, so do they likewise of that of the society to which he belongs. The improved dexterity of a workman may be considered in the same light as a machine or instrument of trade which facilitates and abridges labour, and which though it costs a certain expense, repays the expense with a profit.[12]

In a different passage Smith states:

> There may be more labour in an hour's hard work than in two hour's easy business; or in an hour's application of a trade which cost ten years labour to learn, than in a month's industry at an ordinary and obvious employment.[13]

We can be sure that Smith was aware of the fact that training or education leads to higher income. In fact, one can find numerous examples in Smith that substantiate the fact that he saw some priority in considering training and education as investments in human capital.

Both Kiker and Jensen provide evidence that the concept of human capital is well rooted in classical economic literature. They cite examples in Say, Senior, Malthus, and Mill indicating that there was concern among several of the classical economists for the investments man makes in himself.[14]

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[11] B. F. Kiker, "The Historical Roots of Human Capital," *Journal of Political Economy* (October 1966), p. 448.

[12] Adam Smith, *An Inquiry into the Nature and Causes of the Wealth of Nations* (New York: The Modern Library, 1937), pp. 265-266. (As cited by Jensen, *op. cit.*)

[13] *Ibid.*, p. 31.

[14] Kiker, "The Historical Roots," *op. cit.*, Jensen, *op. cit.*

With the advent of neoclassicism, however, the concept was all but abandoned. The neoclassicists were concerned with distribution, not with growth. W. Stanley Jevons preferred not to attempt to extrapolate the human capital argument, since the science, as he assessed it, was not yet prepared for such a task. He states, "it surely would be absurd to attempt the more difficult question (of dynamics) when the more easy one (of statics) is yet so imperfectly within our power."[15]

Schultz, however, credits Alfred Marshall as the person most responsible for the dormancy of the human capital concept.[16] That Marshall did not include investments in human beings as capital is certain. In his analysis, "personal wealth" was by definition also "internal wealth" which characteristically was not exchangeable. Since man's skills and abilities were a part of his personal wealth, they were also a form of his internal wealth. Marshall did admit that skill and internal wealth contribute to the production of material wealth, but insisted that they be omitted from economic analysis in order that the resulting theory not be detached from the market place.[17]

Today, economists are again concerning themselves with the problems of growth and development. Thus, the emphasis has shifted away from the neoclassical concern with distribution to the same problem that concerned the classicists, namely, production. One of the revitalizations brought about by this change is interest in human capital.

In his presidential address to the American Economic Association in 1960, T. W. Schultz emphasized the need for further research in the area of human capital. Schultz believes that the investments made in human capital, especially in this country, have been grossly understated. He estimated that during the interval 1919-1957 the national income of the United States rose on an average of 3.1 percent per year. Over the same interval, tangible capital rose on an average of only 1.8 percent per year.[18] Denison has stated that 20 percent of this nation's economic growth during the period 1929-1957 may be attributable to investments in human capital.[19] This, of course, is not consistent with the theory that a country that is developing (as the U. S. certainly did over the given interval) should be experiencing capital deepening. Schultz's position is that during the period, a great deal of investment was made in human capital, accounting for the seeming contradiction with capital deepening theory.[20] However, Becker has stated that the difference in marginal returns to human and physical capital is approaching zero, and that increasing human capital investments will have to be justified by other than direct economic criteria.[21]

Marshall Colberg points out another seeming paradox that can perhaps be explained by the concept of investment in human beings.

About a decade ago "Leontief's paradox" received a great deal of attention in the economic journals. Leontief applied his input-output analysis to American foreign trade and found paradoxically, that out exports were labor intensive, while our imports tended to be capital intensive. A simple explanation of the paradox may be that our statisticians have classified too much of our resources as labor and too little as capital.[22]

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[15] W. Stanley Jevons, The Theory of Political Economy, 5th ed. (New York: Kelly & MacMillan, 1957), p. vii (as cited by Jensen, op. cit.).

[16] T. W. Schultz, "Investment in Human Capital, "American Economic Review (March 1961), pp. 1-17.

[17] Alfred Marshall, Principles of Economics (London: The Macmillan Co., 1890), pp. 110-130.

[18] Schultz, op. cit.

[19] Denison, op. cit.

[20] Schultz, op. cit.

[21] Gary Becker, "Underinvestment in Education?" American Economic Review, Proceedings (May 1960), p. 349.

This brief sketch of the development of the concept of human capital, based upon attention given the subject by economists, reveals the importance of investments in human resources as a factor in economic growth.

Recent Empirical Studies

While human capital may arise from investments in health, labor mobility, or market information, the subject of this study will involve only investments made through one form of education, vocational training. The study of vocational training abrogates one serious theoretical difficulty of most human capital studies, that of solving the consumption-investment dichotomy. For the purpose of this study, vocational training will be treated as a pure investment.

Recent Studies

Many empirical studies have attempted to measure the benefit of investment in vocational training.[23] Several studies may be chosen as being representative of the quantifiable approach to the study of human capital. The authors have selected studies for discussion that reflect upon the two aspects of central concern to this study: (1) the length of observation of the subjects in the labor force; and (2) the method of treating income and other effects of vocational training.[24]

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[22] Marshall Colberg, Human Capital in Southern Development (Chapel Hill: University of North Carolina Press, 1965), p. 30.

[23] See for example: Michael E. Borus, "The Economic Effectiveness of Retraining the Unemployed Based on the Experience of Workers in Connecticut," an unpublished Ph. D. dissertation, Yale University, 1964, and "Time Trends in the Benefits from Retraining in Connecticut," Industrial Relations Research Association, Proceedings of the Twentieth Annual Meeting (December 1967); Arthur J. Corazzini, Vocational Education, A Study of Benefits and Costs, submitted to the Office of Education, August 1966; Adger B. Carroll and Loren A. Ihnen, "Costs and Returns for Investments in Technical Schooling by a Group of North Carolina High School Graduates," Economics Research Report No. 5, Department of Economics, North Carolina State University (December 1967); Max Eninger, The Process and Product of T and I High School Level Vocational Education in the United States, Pittsburgh, May 1965; J. J. Kaufman, E. W. Stromsdorfer, et al., An Analysis of Comparative Costs and Benefits of Vocational vs Academic Education in Secondary Schools, Preliminary Report, Pennsylvania State University (October 1967); Daniel C. Rogers, "The Effect of Education on Income," unpublished dissertation, Yale University, 1967; Earl Man, "A Nationwide Evaluation of MDTA Job Training," Journal of Human Resources (Spring 1968); D. A. Page, "Retraining Under the Manpower Development Act: A Cost-Benefit Analysis," Public Policy, Vol. 13 (1964), pp. 257-67; G. G. Somers and E. W. Stromsdorfer, "A Benefit-Cost Analysis of Manpower Retraining," Industrial Relations Research Association, Proceedings (December 1964), pp. 172-185; Michael Taussig, "An Economic Analysis of Vocational Education in New York City Schools," a paper prepared for the Conference on Vocational Education, The Brookings Institution, April 17-18, 1967.

[24] All studies reviewed by the authors have revealed at least some monetary benefit to the recipient in the short-term.

Carroll and Ihnen[25] found in their study of graduates of a two-year technical institute and a matched group of cohorts that although the total cost per institute graduate (private and social) was $7,425, it generated an average return of $1,482 per annum over the expected working life. (A more liberal estimate was also made based upon a 2 percent income growth per annum for graduates and control subjects alike.) Consequently, a rate of return was calculated by both methods resulting in a rate of return of 16.7 percent and 20.1 percent, respectively.

Borus,[26] in his study of time trends in retraining benefits, found that the average gain in earnings was relatively large in the fifth year, indicating that the income advantage from retraining persisted even beyond. The average earnings increased at a rate of 6 percent per annum, and Borus stated that cost-benefits studies should project returns over the expected working life at 6 percent annual increments.

Kaufman et al.[27] observed the employment experiences of a group of vocational-technical school graduates and a matched group of noncollege academic graduates for a six-year period. It was found that the vocational-technical group had higher earnings and rate of employment, but the employment differences were decreasing by the end of the period.

Corazzini[28] measured only starting wages in observing the effects of training in high-school vocational training programs and post high-school vocational training. He found that post high-school vocational training resulted only in a $160 advantage the first year over the vocational high-school graduate. He used the one-year observation as a basis for projection over the expected working life and found that if the $160 differential were discounted at 5 percent, it would not equal the discounted training cost ($4,965) within the expected working life of the graduate.

Somers and Stromsdorfer[29] observed the employment experiences of a group of area vocational training program graduates and a group of not necessarily matched "non-trainees." They found that the expected benefits over the working life by far exceeded the costs, but the observation period was only twenty-four months. The monthly differential, however, did increase from $61 to $65.

The above cited studies reveal some of the ambiguities in the study of the cost-benefits of vocational training with regard to duration of positive income effects, assumptions, and methods involved in their measurements and diversity of study populations within which the phenomena were observed.

Kaufman[30] has leveled some criticism against the work of Corazzini[31] and of Taussig[32] in cost-benefit studies of vocational education not reported upon here. Kaufman stated that neither investigator properly controlled exogenous socio-economic variables, and both made income observations immediately following graduation only. These investigators did not consider the mitigating effects of participation rates upon earned income, but attempted to arrive at income differentials by a comparison of wage rates. While Borus[33] controlled this latter factor by obtaining individual quarterly earnings amounts from the Social Security Administration, he may have failed to match adequately his control group with his experimental group.

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[25] Carroll and Ihnen, op. cit.

[26] Borus, op. cit.

[27] Kaufman et al., op. cit.

[28] A. J. Corazzini, "When Should Vocational Education Begin?" The Journal of Human Resources (Winter 1967), p. 41.

[29] Somers and Stromsdorfer, op. cit.

[30] Kaufman et al., op. cit.

[31] Corazzini, op. cit.

[32] Taussig, op. cit.

Carroll and Ihnen[34] appear to have eliminated many of the shortcomings of the other studies reported, but their conclusions are based exclusively on immediate labor force experience in a local labor market and a relatively homogeneous study population.

This study offers the distinct advantages of lengthening the duration of observation to a period of from one to five years, increasing the rigor of selecting a matched group of cohorts, drawing the total study population from a wide geographic area and from fifteen different vocational curricula, and utilizing individual quarterly income data from the Social Security Administration. In summary, the authors feel they can add to the understanding of vocational training effects by combining many of the previously developed techniques into a method that controls the many potentially invalidating variables. Given this foundation, it will be possible to sharpen the theoretical focus by examining other employment characteristics that may be associated with vocational training in addition to the wage effects of AVTS training.

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[33] Borus, op. cit.

[34] Carroll and Ihnen, op. cit.

Chapter III

THE STUDY POPULATION

Sample Selection

During the summer of 1968 data collectors visited the 19 Tennessee Area Vocational-Technical Schools in operation at that time and examined the records of their ex-students. The records at Ripley, Jacksboro, and Crossville were not examined because these schools had not been in operation long enough to have former students with substantial hours of instruction and departure dates earlier than January 1, 1968, which had been chosen as the cut-off date. Two ex-students selected from the school at Oneida were eliminated because they left the school after the cut-off date, so the study effectively excludes the school at Oneida and includes only 18 schools.

At each school a one-in-four sample of all ex-students was selected in a random and impartial manner, so that each former student had an equal 25% chance of selection as long as the school maintained a permanent record of his attendance. The size of the sample would be a completely accurate indicator of the number of students who left area schools before the summer of 1968 if every school had uniform and accurate record-keeping policies and procedures. This may not be the case, because a number of the sample members appear to have applied for admission to school but never attended classes, and others appear to have ceased attending after a day or two of attendance. Some schools probably discarded records of this type with the result that the sample overstates the number of class attenders and understates the number of persons accepted for enrollment.

The sample numbered 1,701, which implies that about 6,800 students had attended the schools at some time but left before the summer of 1968. This total does not include any students who were enrolled in school at the time the data were collected; it does include students who attended classes at high-schools operating under contract as area schools before the state schools got their own physical facilities. Additional information was collected about certain students chosen from the 1,701 by examination of their high-school records and from responses to a questionnaire mailed to them. For most of the 1,701 members of the one-in-four sample, however, the only information available was that collected from AVTS records. The form used to collect these data is shown in Appendix B as Form A. Tables 1-12 below are all based on this information and provide the best overall picture of the population characteristics of the entire group of 6,800 "alumni" who had left the 18 schools by mid-1968.

Characteristics

Table 1 shows marital status and sex for the sample of 1,701 in numbers and percentages. The rates of marriage do not seem much different from the rates for the general population in these age groups. The ratio of two males per female probably reflects the kinds of programs offered (most of which appear to be dominated by one sex) as well as recruiting efforts. The two-to-one ratio of males to females in the area schools is about the same as the ratio of males to females in the labor force.

Table 2 shows the distribution of I.Q. scores and the median I.Q. for 17 occupational groups. I.Q. scores are known for only 222 of the 1,701 subjects and were obtained from high-school records. Form D, reproduced in Appendix B, was used to collect these data. It should be noted that Table 2 includes only high-school graduates and that these same relationships might not hold for all ex-students in the 17 programs.

Table 1

MARITAL STATUS AND SEX OF SAMPLE

Sex	Married		Other		Total	
	Number	Percent	Number	Percent	Number	Percent
Male	385	22.6	753	44.3	1138	66.9
Female	206	12.1	357	21.0	563	33.1
Total	591	34.7	1110	65.3	1701	100.0

Table 2

TYPE OF PROGRAM BY I.Q. FOR 222 SUBJECTS WITH I.Q. SCORES

Program	Number of Students	61-70	71-80	81-90	91-100	101-110	111-120	121-130	131-140	Median*
Drafting	36	--	1	5	14	7	6	3	--	100
Welding	17	--	1	6	6	2	2	--	--	92
Office Occupations	64	--	--	7	20	20	13	2	2	103.5
Electronics	17	--	1	2	4	6	3	1	--	104
Auto Mechanics	21	1	--	6	8	3	3	--	--	94
Machine Shop	16	--	--	5	6	5	--	--	--	98.5
Refrig. & A. C.	10	--	--	1	4	3	2	--	--	100.5
Small Gas Engines	4	--	--	1	2	--	1	--	--	92.5
Radio - TV	7	--	2	--	4	--	1	--	--	96
Lic. Prac. Nurse	17	--	--	3	7	3	3	1	--	95
Auto Body Repair	1	--	--	--	--	1	--	--	--	--
Civil Technician	1	--	--	--	1	--	--	--	--	--
Operating Room Tech.	2	--	--	--	1	--	1	--	--	--
Sheet Metal Work	1	--	--	--	--	1	--	--	--	--
Shoe Repair & Leather	1	--	--	1	--	--	--	--	--	--
Cert. Lab. Asst.	6	--	--	--	1	4	--	1	--	105
Office Mach. Repair	1	--	--	--	1	--	--	--	--	--
Total	222	1	5	37	79	55	35	8	2	100

*Medians are not computed for categories with less than five observations.

In terms of measured I.Q., the brightest students have tended to study as certified lab assistants or in electronics, office occupations, or refrigeration. The lowest I.Q.'s appear among students choosing welding, small gas engines, auto mechanics, and practical nursing. It is not clear whether these relationships are the result of program choice by the students or the operations of the counseling and guidance procedures at the schools.

Table 3 gives the same sort of information with the G score from the GATB test substituted for the I.Q. score. The number of observations is now considerably higher (though GATB scores for a thousand of the subjects could not be found in the school records), and the data include dropouts as well as high-school graduates. Electronics and certified lab assistant again show scores above the average, joined by drafting, office machine repair, and machine shop. Students in small gas engines and welding again appear to have the lowest levels of general ability.

Taken together, Tables 2 and 3 show that the area schools have drawn a considerable range of intellectual talent, with a substantial number of highly competent students who could almost certainly have succeeded or even excelled in four-year degree programs, and an even larger number with aptitude scores so low that their ability to profit from a two-year program approaching the technical level must be questioned. For the slow-learning group an MDTA-type approach, emphasizing basic education along with vocational training and short-term courses to prepare for entry-level jobs, may be more appropriate than the two-year programs of a purely vocational type, aimed at higher skill levels, that appear to be the more appropriate domain for the area vocational-technical schools. The investigators would estimate the first group at about 5 percent of the student body, approximately the proportion of former students with I.Q. or GATB G scores over 120. The group of slow learners can be estimated at about 10 percent of all students, corresponding to those with GATB scores below 80. There are fewer students with low I.Q. scores than with low GATB scores, because I.Q. scores were obtained only for high-school graduates.

Table 3

TYPE OF PROGRAM BY GATB FOR 681 SUBJECTS WITH GATB SCORES

Program	No. of Students	41-50	51-60	61-70	71-80	81-90	91-100	101-110	111-120	121-130	131-140	141-150	Median*
Drafting	66	--	--	1	--	6	15	20	18	6	--	--	107
Welding	58	--	2	3	14	14	15	7	2	1	--	--	88.5
Office Occupations	202	--	--	1	14	51	56	47	21	8	3	1	97
Electronics & Electricity	64	--	--	1	4	7	17	17	12	4	2	--	102
Auto Mechanics	78	1	2	3	3	16	19	23	7	4	--	--	98
Machine Shop	59	--	--	--	2	5	21	16	10	5	--	--	101
Refrig. & A. C.	42	--	--	1	2	9	12	14	3	1	--	--	98.5
Small Gas Engines	16	--	3	5	6	--	2	--	--	--	--	--	71
Cosmetology	5	--	--	1	--	1	3	--	--	--	--	--	94
Radio & TV Repair	12	--	--	2	--	3	4	2	1	--	--	--	95.5
Lic. Prac. Nurse	48	--	--	--	1	7	20	17	2	1	--	--	97.5
Nurses' Aide	1	--	--	--	--	1	--	--	--	--	--	--	--
Auto Body Repair	4	--	--	--	1	1	--	1	1	--	--	--	--
Supply Room Technician	4	--	--	1	--	2	1	--	--	--	--	--	--
Sheet Metal Worker	1	--	--	--	--	--	--	1	--	--	--	--	--
Certified Lab Asst.	11	--	--	--	--	--	5	4	2	--	--	--	100
Office Mach. Repair	6	--	--	--	--	2	1	1	2	--	--	--	101.5
Unknown	4	--	--	--	--	1	3	--	--	--	--	--	--
Total	681	1	7	19	47	126	194	170	81	30	5	1	98

*Medians are not computed for categories with less than five observations.

Tables 4, 5, and 6 give hours of instruction for each type of program and show the retention rates for training in each occupation. All three tables involve the same information; Table 4 shows numbers of students (about 100 students are not included in the table because their hours of instruction or type of program were unknown, or because they were in some program such as watchmaking or woodworking that was too small to be shown separately and could not be included under any of the 13 occupation groups); Table 5 shows percentages, and Table 6 shows cumulative percentages.

Almost half of the former students in the sample left school before completing 400 hours of instruction, and more than a third left before completing 200 hours. The practical nursing and laboratory assistant programs stand out from the rest in high retention rates, with each holding a majority of its students for more than 2000 hours. The only other programs that kept a majority of their students for more than 600 hours were drafting and machine shop, and five of the programs had attrition rates over 50% before reaching even 400 hours of instruction. The high retention rates seem to be associated with licensing or certification requirements geared to school attendance.

Table 4

HOURS OF INSTRUCTION BY TYPE OF PROGRAM

	Hours of Instruction																	
Type of Program	0	1-199	200-399	400-599	600-799	800-999	1000-1199	1200-1399	1400-1599	1600-1799	1800-1999	2000-2199	2200-2399	2400-2599	2600-2799	2800-2999	3000+	Total
	Number of Students																	
Drafting	7	39	25	10	11	11	11	6	7	7	4	5	5	8	4	3	--	163
Welding	18	55	26	16	25	15	17	15	6	2	3	1	1	--	--	--	--	200
Office Occ.	44	142	68	43	35	31	25	17	18	3	2	--	1	2	1	--	--	432
Electronics	4	33	33	14	11	4	4	5	--	6	3	3	3	--	1	4	2	130
Auto Mech.	10	53	21	15	18	11	10	9	10	5	1	3	3	6	5	2	1	183
Machine Shop	4	34	10	9	6	17	11	2	2	5	3	2	5	1	4	4	1	120
Refrig. & A. C.	12	19	15	8	7	3	9	4	4	1	4	2	4	--	1	3	1	97
Small Gas. Eng.	5	28	12	7	11	3	8	1	1	--	--	--	--	--	--	--	--	76
Cosmetology	1	10	10	--	2	--	1	2	3	--	--	--	--	--	--	--	--	29
Radio & TV	5	15	6	4	5	1	1	1	5	1	--	1	--	--	--	1	--	46
Lic. Prac. Nurse	8	4	2	6	--	--	1	--	1	1	3	70	--	--	--	--	--	96
Shoe Repair	1	6	1	2	--	1	--	--	1	1	--	--	--	--	1	2	1	17
Cert. Lab. Asst.	--	--	1	--	--	--	--	--	--	--	--	12	--	--	--	--	--	13
All Programs	119	438	230	134	131	97	98	62	58	32	23	99	22	17	17	19	6	1602

Table 5

HOURS OF INSTRUCTION BY TYPE OF PROGRAM

Type of Program	Hours of Instruction 0	1-199	200-399	400-599	600-799	800-999	1000-1199	1200-1399	1400-1599	1600-1799	1800-1999	2000-2199	2200-2399	2400-2599	2600-2799	2800-2999	3000+
	Percentage Distribution																
Drafting	4.5	23.9	15.3	6.1	6.7	6.7	6.7	3.7	4.3	4.3	2.5	3.1	3.1	4.9	2.5	1.8	--
Welding	9.0	27.6	13.1	8.0	12.6	7.6	8.5	7.6	3.0	1.0	1.5	0.5	--	--	--	--	--
Off. Occ.	10.2	32.9	15.7	10.0	8.1	7.2	5.8	3.9	4.2	0.7	0.5	--	0.2	0.5	0.2	--	--
Electronics	3.1	25.4	25.4	10.8	8.5	3.1	3.1	3.8	--	4.6	2.3	2.3	2.3	--	0.8	3.1	1.5
Auto Mech.	5.5	29.0	11.5	8.2	9.8	6.0	5.5	4.9	5.5	2.7	0.5	1.6	1.6	3.3	2.7	1.1	0.5
Machine Shop	3.3	28.3	8.3	7.5	5.0	14.2	9.2	1.7	1.7	4.2	2.5	1.7	4.2	0.8	3.3	3.3	0.8
Refrig. & A. C.	12.4	19.6	15.5	8.2	7.2	3.1	9.3	4.1	4.1	1.0	4.1	2.1	4.1	--	1.0	3.1	1.0
Small Gas Eng.	6.6	36.8	15.8	9.2	14.5	3.9	10.5	1.3	1.3	--	--	--	--	--	--	--	--
Cosmetology	3.4	34.5	34.5	--	6.9	--	3.4	6.9	10.3	--	--	--	--	--	--	--	--
Radio & TV	10.4	31.2	12.5	8.3	10.4	2.1	2.1	2.1	10.4	2.1	--	--	2.1	--	--	6.2	--
Lic. Prac. Nurse	8.3	4.2	2.1	6.3	--	--	1.0	--	1.0	1.0	3.1	72.9	--	--	--	--	--
Shoe Repair	5.9	35.3	5.9	11.8	--	5.9	--	--	5.9	5.9	--	--	--	--	5.9	11.8	5.9
Cert. Lab. Asst.	--	--	7.7	--	--	--	--	--	--	--	--	92.3	--	--	--	--	--
All Programs	7.4	27.3	14.4	8.4	8.2	6.1	6.1	3.9	3.6	2.0	1.4	6.2	1.4	1.1	1.1	1.2	0.4

Table 6

HOURS OF INSTRUCTION BY TYPE OF PROGRAM

	Hours of Instruction																
Type of Program	0	Less Than 200	Less Than 400	Less Than 600	Less Than 800	Less Than 1000	Less Than 1200	Less Than 1400	Less Than 1600	Less Than 1800	Less Than 2000	Less Than 2200	Less Than 2400	Less Than 2600	Less Than 2800	Less Than 3000	Total
	Cumulative Percentage																
Drafting	4.3	28.2	43.6	49.7	56.4	63.2	69.9	73.6	77.9	82.2	84.7	87.7	90.8	95.7	98.2	100.0	--
Welding	9.0	36.7	49.7	57.8	70.4	77.9	86.4	94.0	97.0	98.0	99.5	100.0	--	--	--	--	--
Office Occ.	10.2	43.1	58.8	68.7	76.9	84.0	89.8	93.7	97.9	98.6	99.1	99.1	99.3	99.8	100.0	--	--
Electronics	3.1	28.5	53.8	64.6	73.1	76.2	79.2	83.1	83.1	87.7	90.0	92.3	94.6	94.6	95.4	98.5	100.0
Auto Mech.	5.5	34.4	45.9	54.1	63.9	69.9	75.4	80.3	85.8	88.5	89.1	90.7	92.4	95.6	98.4	99.5	100.0
Machine Shop	3.3	31.7	40.0	47.5	52.5	66.7	75.8	77.5	79.2	83.3	85.8	87.5	91.7	92.5	95.8	99.2	100.0
Refrig. & A. C.	12.4	32.0	47.4	55.7	62.9	66.0	75.3	79.4	83.5	84.5	88.7	90.7	94.8	94.8	95.9	99.0	100.0
Small Gas Eng.	6.6	43.4	59.2	68.4	82.9	86.8	97.4	98.7	100.0	--	--	--	--	--	--	--	--
Cosmetology	3.4	37.9	72.4	72.4	79.3	79.3	82.8	89.7	100.0	--	--	--	--	--	--	--	--
Radio & TV	10.4	41.7	54.2	62.5	72.9	75.0	77.1	79.2	89.6	91.7	91.7	91.7	93.7	93.7	93.7	100.0	--
Lic. Prac. Nurse	8.3	12.5	14.6	20.8	20.8	20.8	21.9	21.9	22.9	24.0	27.1	100.0	--	--	--	--	--
Shoe Repair	5.9	41.2	47.1	58.8	58.8	64.7	64.7	64.7	70.6	76.5	76.5	76.5	76.5	76.5	82.4	94.1	100.0
Cert. Lab. Asst.	--	--	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	100.0	--	--	--	--	--
All Programs	7.4	34.8	49.1	57.5	65.7	71.7	77.8	81.7	85.3	87.3	88.8	94.9	96.3	97.4	98.4	99.6	100.0

Table 7 gives the age distribution of the sample by single years of age to age 45, with the data grouped for the 4 percent of the students who were over 45. A few ex-students were ommitted from this tabulation because their ages could not be determined from school records. Table 8 gives this same information for years of schooling.

Table 9, like several of the earlier tables, shows the different characteristics of the former students in terms of the programs they studied at the area vocational-technical school. The columns on GATB and I.Q. scores repeat data already presented in Tables 2 and 3. The programs for auto body repairmen and laboratory assistants seem to have drawn the youngest students, while median age is highest for office machine repairmen, nurses' aides, shoe repairmen, and practical nurses.

Since most of the area school ex-students were high-school graduates, the median years of education were 12 for most programs. Dropouts and students with only elementary schooling, however, outnumbered high school graduates in shoe repairing, cosmetology, small gas engines, and welding.

Table 9 introduces a variable not encountered earlier, high-school rank. Like I.Q., this figure was obtained from high-school records of graduates only (Form D in Appendix B shows the information collected from this source) and therefore is available only for the 227 of the 1,701 members of the 25% sample who were high-school graduates. Most high-school records showed the rank of each student among the graduating seniors. The rank was inverted and its base changed to 100 so that the class valedictorian would have a score of 100 for high-school rank and all other students would fall on a scale from zero to 100. The 227 members of the sample had a median rank of 39, which implies that the typical high-school graduate attending area vocational-technical school directly after high school would rank 39th from the bottom (or 62nd from the top) in a graduating class of 100. Here, too, there were substantial differences among programs, with students in training as laboratory assistants or for office occupations ranking well into the top half of their high-school class, and students in refrigeration, radio and TV repair, and auto mechanics ranking particularly low in high-school grade-point averages. It should be emphasized again that these data apply only to a high-school graduate sub-sample among the alumni.

Table 7

AGE DISTRIBUTION OF 1681 STUDENTS

Years of Age at Time of First Enrollment	Number of Students	Cumulative Percentage
16	14	.8
17	247	15.5
18	351	36.4
19	187	47.4
20	97	53.3
21	80	58.1
22	77	62.6
23	57	66.0
25	42	72.3
26	32	74.2
27	47	77.0
28	31	78.9
29	40	81.3
30	23	82.6
31	21	83.4
32	30	85.7
33	20	86.9
34	16	87.8
35	22	89.1
36	11	89.8
37	12	90.6
38	12	91.3
39	7	91.7
40	21	93.0
41	5	93.3
42	18	94.3
43	10	94.9
44	9	95.5
45	9	96.0
46-50	38	98.3
51-55	14	99.1
56-60	8	99.6
61-70	7	100.0

Table 8

YEARS OF SCHOOLING FOR 1642 SUBJECTS

Years of Schooling	Number of Subjects	Percent of Total	Cumulative Percent
1	1	.1	.1
2	2	.1	.2
3	0	0	.2
4	3	.2	.4
5	8	.5	.9
6	14	.9	1.7
7	24	1.5	3.2
8	103	6.3	9.4
9	86	5.2	14.7
10	120	7.3	22.0
11	104	6.3	28.3
12	1,100	67.0	95.3
More than 12	77	4.7	100.0

Table 9

VOCATIONAL PROGRAM CHARACTERISTICS

Occupation	Median GATB*	Median I.Q.	Median Age	Median Years School	Median H. S. Rank
Drafting	n=66 107	n=36 100	n=165 19	n=165 12	n=35 26
Welding	n=58 88.5	n=17 92	n=204 21	n=200 11	n=17 26
Office Occupations	n=202 97	n=64 103.5	n=429 19	n=413 12	n=65 63
Elect.	n=64 102	n=17 104	n=130 20	n=129 12	n=19 30
Auto. Mech.	n=78 98	n=21 94	n=183 19	n=180 12	n=22 24
Machine Shop	n=59 101	n=16 98.5	n=119 19	n=117 12	n=20 37.5
Refrig. & A. C.	n=42 98.5	n=10 100.5	n=97 22	n=94 12	n=9 12
Small Gas Eng.	n=16 71		n=81 20	n=77 10	
Cosmetology	n=5 94		n=29 19	n=29 10	
Radio & TV	n=12 95.5	n=7 96	n=53 22	n=52 12	n=7 16
Lic. Prac. Nurse	n=48 97.5	n=17 95	n=95 23	n=94 12	n=17 44
Nurse Aid			n=6 27.5	n=6 11.5	
Auto Body			n=9 18	n=9 12	
Shoe Repair			n=16 23	n=16 9	
Cert. Lab. Asst.	n=11 100	n=6 105	n=13 18	n=13 12	n=6 64.5
Off. Mach. Rep.	n=6 101.5		n=11 32	n=10 12	
All Programs	98	100	20	12	39

*Median not shown where base is less than 5.

Table 10 gives the same information as Table 9, but here the former students are differentiated by school attended rather than by program taken in school. It shows large differences among the schools in all of the variables discussed earlier. The differences among schools and the differences among programs are interlocking in a way that makes it difficult to interpret the differences. For example, office occupations were introduced relatively late at the Knoxville School with the result that the Knoxville sample contained almost no students in this area. Table 9 shows that students in office occupations had high rank in their high-school class and a number large enough to exert a strong influence on the state total. Knoxville's median high-school rank of 27, among the lowest in the state, may be caused entirely by the fact that little instruction was given in office occupations before 1968, and may have nothing at all to do with the school's recruiting or the economic characteristics of the surrounding territory.

Table 10

AREA SCHOOL CHARACTERISTICS*

School	N	Median I.Q.	Median GATB	Median H. S. Rank	Median Age
McKenzie	88	105	101	45	18
Newbern	83	103	103	62	19
Crump	65	91	103	64.5	19
Jackson	68	100	101	53	19
Memphis	454	100.5	94	57	22
Covington	21	--	95	--	19
Shelbyville	90	99	98	23	19
Nashville	207	96	104	26.5	20
Dickson	33	100	102	39	19
Hohenwald	27	--	94.5	--	21
Livingston	36	--	97	--	25.5
Hartsville	24	93	86	42	18
McMinnville	60	--	--	63	21
Elizabethton	36	109	100	54	18
Morristown	28	97.5	94	53.5	19
Knoxville	301	97.5	--	27	20
Athens	47	--	100	39	19
Oneida	2	--	--	--	--
Blountville	31	--	100	--	23.5
State Median	1701	100	98	39	20

*Median not shown where base is less than 5.

Table 11 shows the degree of linear correlation or association among the variables discussed in all the earlier tables. In interpreting these numbers, the following relationships should be kept in mind. A coefficient of +1 represents perfect positive correlation. If the height of people and their weight had a correlation of +1, tall people would invariably be heavier than short people, and we could predict a person's weight with perfect accuracy if we knew his height. A coefficient of -1 represents equally perfect, but negative correlation. If heights and weights had a correlation of -1, tall people would invariably be lighter than short people. We could still predict with perfect accuracy, but our predictions would be directly opposite from the earlier set. A coefficient of zero represents no correlation. If heights and weights had no correlation, a tall person would be equally likely to be heavy or light when compared with a short person, and knowing a person's height would be of absolutely no help in guessing his weight. A correlation greater than zero but less than 1 represents imperfect positive association. This is in fact the nature of the relationship between height and weight; it will be helpful to know an individual's height if you are guessing his weight, but you are bound to make a lot of errors in your guesses if height is all you know about the individual. As the correlation gets closer to zero, your errors become more and more frequent and serious. The same is true for negative correlations, which are imperfect as soon as they become greater than -1 and approach a predictive power of zero as the size of the correlation increases to zero.

Table 11 lists nine variables in matrix form, with the correlations computed among all the variables and placed at the intersection of the two variables. An example may make this clearer. We wish to know the correlation between I.Q. score and high-school rank. We look at the I.Q. row and follow it to the high-school rank column, and read +.35 as the correlation. (We can also obtain this same answer from the high-school rank row and the I.Q. column.) We conclude that intelligent students tend to rank higher in their class than dull students, but that the relationship is not perfect. In a small amount of space, then, Table 11 presents a great deal of information. When no figure appears in a cell, this indicates a correlation so low that it may be taken as zero with only a 5% chance of error (1 in 20).

Table 11

CORRELATION MATRIX FOR SELECTED VARIABLES

	Sex	GATB	I.Q.	Age	Years of School	Hours of Instruction	High School Rank	Urban-Rural Residence	Marital Status
Sex			+.221	+.058	+.190		+.503	−.115	
GATB			+.587	−.188	+.363	+.132			
I.Q.	+.221	+.587		−.234	*	−.155	+.357		
Age	+.058	−.188	−.234		−.156	−.060	−.134	−.148	−.492
Years of School	+.190	+.363	*	−.156		+.051	*		+.106
Hours of Instruction		+.132	−.155	−.060	+.051			−.143	+.106
High School Rank	+.503		+.357	−.134	*				−.055
Urban-Rural Residence	−.155			−.148		−.143			
Marital Status				−.492	+.106	+.085	−.055		

*Could not be computed, since I.Q. scores and high school ranks were available only for subjects with 12 years of schooling.

Sex: A positive correlation means females are higher in the specified characteristic, while a negative correlation means males are higher.

Urban-Rural Residence: A positive correlation means rural students are higher in the specified characteristic, while a negative correlation means urban students are higher.

Marital Status: A positive correlation means married students are lower in the specified characteristic, while a negative correlation means they are higher.

All correlations shown are statistically significant at the 5% level; where no correlation is shown, the coefficient did not differ significantly from zero.

Table 11 shows 21 significant correlations between the listed variables. In Table 12 the significant correlations are listed in order of significance. The implications of Tables 11 and 12 can be summarized in 21 statements, with the descending statement numbers implying a decreasing degree of confidence in the statement. (1) The higher a student's score on the GATB G component, the higher his measured I.Q. (2) The girls who graduated from high-school and attended AVTS had higher grades in high-school than boys who did the same. (3) The married students at AVTS are older than the single ones. (4) Students score higher on the GATB G when they have more formal schooling. (5) Among high-school graduates, the students with higher measured I.Q.'s had higher high-school grades. (6) The younger an AVTS student, the higher his I.Q. is likely to be. (7) Girls have higher I.Q.'s than boys when each are high-school graduates. (8) Girls among the AVTS alumni group have more years of formal schooling than boys. (9) Younger AVTS students have higher GATB G scores than older ones. (10) The younger an AVTS student, the higher his years of formal schooling. (11) The higher a student's I.Q., the sooner he will tend to drop out, and the lower his I.Q., the longer he will tend to remain in AVTS. (12) In the student body, the girls are more likely to have rural backgrounds than the boys. (13) The older an AVTS student, the more likely he is to have a rural background. (14) Students with an urban background tend to remain in AVTS longer, while rural students drop out quicker. (15) The higher a student's score on the GATB G, the more likely he is to remain in area school, while a low G score indicates a greater tendency toward early dropouts. (16) Among high-school graduates, the younger ones have better grades. (17) Married AVTS students have fewer years of formal schooling than others. (18) Married students drop out of AVTS sooner, while others tend to stay longer. (19) Younger students drop out sooner, while older students stay longer. (20) Female students tend to be older than male AVTS students. (21) More formal schooling helps keep AVTS students in school, and those students with less schooling drop out sooner. The truth of each of these statements is confirmed by the coefficient of correlation in Table 12 with the same number.

Table 12

SIGNIFICANT CORRELATIONS AMONG THE VARIABLES

(1)	+.59r	GATB & I.Q.
(2)	+.50r	Sex and High School Rank
(3)	–.49r	Marital Status and Age
(4)	+.36r	GATB & Years of School
(5)	+.36r	I.Q. & High School Rank
(6)	–.23r	I.Q. & Age
(7)	+.22r	Sex and I.Q.
(8)	+.19r	Sex and Years of School
(9)	–.19r	GATB & Age
(10)	–.16r	Age & Years of Schooling
(11)	–.16r	I.Q. & Hours of Instruction
(12)	+.16r	Sex and Urban-Rural Residence
(13)	–.15r	Age & Urban-Rural Residence
(14)	–.14r	Hours of Instruction & Urban-Rural Residence
(15)	+.13r	GATB & Hours of Instruction
(16)	–.13r	Age & High School Rank
(17)	+.11r	Marital Status & Years of School
(18)	+.09r	Marital Status & Hours of Instruction
(19)	–.06r	Age & Hours of Instruction
(20)	+.06r	Sex and Age
(21)	+.05r	Years of School and Hours of Instruction

The population characteristic that gives most cause for concern is the "hours of instruction" figure, which indicates that the schools are doing a spotty job of retaining their students until they become employable. Even though the schools are geared to individualized instruction, so that they will discharge the more apt students before the completion of a full two-year term of instruction, it is impossible to believe that their resources are being utilized efficiently when so many of the alumni have so few hours of instruction completed. The authors believe the statistics show that increasing the holding power of the schools ought to be an important policy goal of the system, and the following tentative suggestions are offered in this direction:[35]

1. The learning progress of each student could be evaluated in a uniform manner by instructors and reported to guidance counselors, and average overall evaluation recorded and placed in permanent records, the latter so that the average and above students would not be penalized in the job market. For students with difficulty in training progress, the counselor and instructor could give individual attention both to the training problem itself and perhaps more importantly to the attendant morale or ego problems.

2. More individual attention could be given to students by counselors, attendant to problems of personal adjustment at school, relationship of training at the school to economic improvement in the job market, helping the student make a commitment to his training period, overcome acute periods of discouragement that may result in dropout, etc. The tone of the area schools may be too training-centered without enough social structure and cohesion due to the transitory nature of the situation and the short-term outlook.

3. The counseling services could be attuned to include attention to economic strains the students may be suffering at home as a consequence of training, problems of adjusting job schedules to school schedules, etc.

4. Standards could be developed to drop students when it becomes evident that they will not or cannot progress in training. Consideration could be given to accepting students on a provisional basis for a month or so, spending less time and money on them in initial stages, withholding expensive, individualized training until attendance commitment has been demonstrated.

Sub-Sample Selection

After examination of the characteristics of the entire group of former students, the next step was the selection of the subjects to be used in measuring the benefits of training. Initially, five groups were excluded for the following reasons: (1) If the record indicated that the subject was currently serving in the armed forces, he was excluded on the grounds that he might be denied an opportunity to use his training in gainful employment and that his earnings were not likely to bear a close relationship to his productivity even if he was able to make use of his AVTS training in the military service. (2) If the record showed less than 300 hours of instruction, the student was arbitrarily excluded from further analysis on the grounds that his training was probably not substantial enough to have much impact upon his earnings record after leaving school. An examination of Table 4 will show that large numbers of the 1,701 students were excluded by this rule; the selection of 300 hours (about three months) was arbitrary, and a higher or lower limit could certainly have been chosen with equal justification. (3) If the student left AVTS after January 1, 1968, he was excluded on the grounds that he could not have a full year of experience in the labor force by the time the questionnaire was mailed in early 1969, and that it was desirable to base the study on substantial labor force experience beyond departure from school, not just placement on an initial job. (4) If the record indicated a substantial physical disability, or the financial support of the student by the state rehabilitation agency, the student was excluded on the grounds that his earnings after school would combine the effects of vocational training with the rehabilitation process, and it would be impossible to separate the two effects. (5) If the record indicated that the student left AVTS to attend college, he was excluded on the grounds that his college attendance would (temporarily) tend to lower his earnings though not his earning capacity.

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[35] It must be borne in mind that an open admission policy extant in the AVTS system necessarily results in a high dropout rate. Our suggestions are proffered only to minimize an inherent problem.

After these five exclusions, a net sample of 679 suitable students remained. A questionnaire was sent to each of these subjects.

Three draft questionnaires were developed on the basis of information required for analysis. A psychological consultant was used in initially constructing the instruments, and they were then pretested for cognition and comprehensibility of responses by administering them to job applicants at the Tennessee Department of Employment Security. The questionnaries were modified accordingly. A pretest procedure was then developed to determine which of the questionnaires would obtain the highest response rate and most comprehensive data. Three separate pretest simulations of the actual procedure were performed, utilizing the students excluded from the original sample of 1,701 students and selected groups of former high-school students representing both rural and urban areas. This procedure was necessary in order to predict the expected different response rates for the former area vocational-technical school students and their classmates. Higher response rates were anticipated from the former AVTS students who were expected to have greater appreciation of the vocational orientation of the study, and also their addresses were more recent.

In effect, the complexity of the questionnaire was varied with and without a payment, 25 cents in one case and 50 cents in another, to the recipient for services rendered. By far the best results were obtained by using the moderately complex questionnaire in the presence of a payment of 50 cents. This combination resulted in a pretest response rate of 75 percent for former AVTS students and 50 percent for the high-school students, with a high quality of response in both cases.

Appendix B, Form B, is the questionnaire developed by this procedure and mailed to the 679 suitable subjects. It was accompanied by a Social Security Card (Appendix B, Form C), a covering letter (Appendix B, Form E), and 50 cents. A postcard reminder was mailed to those not responding to the initial questionnaire, and another questionnaire and letter (Appendix B, Form F), were mailed to those not responding to the postcard.

Under ideal circumstances, it would have been desirable to select a matched control subject for each of the 679 students to whom questionnaires were mailed and from whom Social Security earnings records were sought. This proved impossible in some cases, and it would have been prohibitively expensive in others. Again it was found necessary to adopt three exclusions, which are enumerated here, along with the reason for each exclusion. (1) Students who failed to graduate from a Tennessee high school were excluded. It was found that most high schools kept good records of their graduates, but not of their dropouts. The sample included a girl who graduated from high school in Newfoundland and a man who left school at age 10 in England. The budget was not adequate to sustain travel to Newfoundland and England. (2) Anyone born before January 1, 1943, was excluded. The reason was partly expedience, for it was found that school consolidations made many older records inaccessible, and fewer schools administered standardized I.Q. tests in earlier years. There were also analytical reasons for the exclusion. It was felt that students much more than 20 years old at enrollment were unlikely to be able to give accurate information about their educational experiences of so many years ago and more likely to be "contaminated" by other experiences, such as training in the armed forces or on the job, so that their earnings were less directly related to their experiences in the Area Vocational-Technical Schools. (3) Anyone with a record of college attendance before his AVTS attendance was excluded on the grounds that the college experience might tend to increase his earning capacity.

The students excluded by these rules were not excluded from the overall study, and they received the same questionnaire as the high-school graduates born since 1943. They were excluded from the matching process, and no attempt was made to deduce their probable labor force experience in the absence of vocational training by examining the labor force experience of their untrained schoolmates. The three exclusions eliminated 345 of the 679 students in the net sample, and attempts were made to find matched schoolmates for the remaining 334.

The location of matched classmates involved a visit to each high school which had an alumnus in the refined sample of 334. A number of high schools in the Knoxville area were visited and a procedure for data collection was developed on the basis of these visits. The next step was to enlist the guidance counselors at the Area Vocational-Technical Schools as members of the research team. The counselors were instructed in the collection of data at a meeting in Knoxville and were given lists of high schools and students for investigation. They visited the high schools in their own areas and collected a considerable amount of information about each student using the form attached in the Appendix as Form D. The counselors were instructed to select six potential matches for each experimental subject, all with the same race and sex, and with the closest possible grade-point averages. The other data did not enter into the selection of the six potential matches, but they were subsequently used to select the acceptable matches (usually two or three) from the potential matches.

In the selection of the acceptable matches, i.e., those high-school classmates resembling the AVTS alumni so closely that they could be treated as reasonable substitutes for one another, the following criteria were adopted: (1) students were matched only when their I.Q. scores differed by less than 10 points; (2) students were matched only when their grade-point averages diverged by less than 10% of the maximum, i.e., by .4 point on a scale where 4 is the highest grade or by 10 points on a scale of 100; (3) children of professional or managerial fathers were not matched with students having fathers in other occupations;[36] and (4) academic students (defined as students with two years of a foreign language, two years of higher mathematics, and two years of a laboratory science) were not matched with other students. An attempt was made to select at least three matches for each former AVTS student, since the pretest of the questionnaire indicated that the matches would have a lower response rate.

Eighty-five students were lost in the matching process, because it proved impossible to match them in spite of the best efforts of the school counselors and return trips to the high school in a few cases. This group includes: (1) a number of students who appeared to have falsified their educational attainments on their AVTS applications, including some who claimed high-school graduation but were known to be dropouts and others who were unknown at the high school from which they claimed to have graduated; (2) those with extremely high or low grade-point averages relative to their measured I.Q.'s indicating great underachievement or overachievement in high school; (3) the graduates of a few high schools merged out of existence, a high school whose records were being microfilmed, and a high school destroyed by fire, all of which made records inaccessible; (4) a black student who attended a predominantly white high school; and (5) a few graduates of extremely small high schools, in which all potential matches had gone to college or were serving in the armed forces.

Two hundred forty-nine matched students remained after these losses, and they were mailed the questionnaire (Form B) along with the attachments and follow-up materials discussed earlier. Similar mailings, with only minor differences in the wording of the covering letter, follow-up letter, and item 8 of the questionnaire, were sent to high-school graduates without training in the Area Vocational-Technical Schools. The analyses presented in Chapter IV are based principally on the tabulated replies to this questionnaire including respondents' statement of earnings; the analyses reported in Chapters V and VI are based upon earnings data later received from the Social Security Administration.

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[36] In many cases the school records did not include parent's occupation, and in many other cases the school record was not usable because it gave an employer or industry instead of an occupation.

Response to the questionnaire exceeded expectations. About 11 percent of the mailing could not be delivered by the post office. (Some of the addresses were several years old, and more recent addresses could not be obtained even though the guidance counselors at the high schools and the area schools were most helpful in locating up-to-date addresses for the other 89 percent.) Of the letters delivered to the AVTS graduates by the post office, responses were received in 82.6 percent of the cases. The response rate was 73.4 percent for the total sample of AVTS ex-students, even if those students to whom it was impossible to deliver a questionnaire were counted as non-respondents.

Sample Representativeness

The question must now be asked and answered as to the representativeness of the respondents to the overall study population. Unless there is 100 percent response from a sample, there is always the problem of determining whether the respondents differed significantly from the non-respondents with regard to variables that could bias findings based upon respondent data only. For example, in this study, if women responded more frequently than men, urban residents more frequently than rural, non-migrants more frequently than migrants, or high-earners more frequently than low-earners, general conclusions based upon the labor force experiences of the respondents could be highly biased in the direction of the over-represented subgroups.

There are steps that can be taken to avoid this invidious path to confusion. First, one must extablish statistically whether the respondents and non-respondents differ with regard to distinguishable characteristics. If they do not, it may be assumed that the response is unbiased. If the response is determined by this test to be biased, an estimate of the bias can be made by comparing the subgroups among the respondents (rurals with the urbans, males with the females, etc.) to determine how they tend to differ with regard to labor force experience. If the subsets do differ, then weights can be estimated to apply to general conclusions, neutralizing specific biases. Or, in lieu of general conclusions, specific conclusions concerning only the subgroups can be made.

In this study, the respondents have been compared with the non-respondents with regard to sex, specific Area Vocational-Technical School attended, instructional program, marital status, GATB G component, I.Q. score, age, hours of instruction, and rural-urban residence. Statistical tests revealed that the respondent sample was over-represented by females and female-related characteristics and, as a result, appears concentrated in health and office occupations, high in mean rank in high school class and rural residence.[37] This is partially explained by females having a higher response rate and by a high service rate in the armed forces for males. The above notwithstanding, there is no reason to reject the assumptions that the male sample members are representative of the male target population and similarly for the females.

Characteristics of the AVTS Population

1. A majority of the students (57%) were from the three largest schools, Memphis, Knoxville, and Nashville; Memphis was the largest school, with 27% of the total alumni body.
2. A majority (58%) of the students were in the four largest occupational programs: office occupations, welding, auto mechanics, and drafting. Office occupations (26%) was the largest group.
3. Forty-four percent of the student body were unmarried males; the split was about 2 to 1 between men and women and about 2 to 1 between single and married.

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[37] For a more complete treatment, see R. L. Bowlby and W. R. Schriver, "Non-Wage Benefits of Vocational Training: Employability and Mobility," op. cit.

4. A majority (53%) of the students had reasonably average GATB G scores from 91 to 110; 17% were extremely high (GATB of 111 or higher), and 29% were extremely low (GATB of 90 or lower).

5. A majority (60%) of the high-school graduates had reasonably normal I.Q. scores from 91 to 110; 20% were extremely high (I.Q. of 111 or higher), and 19% were extremely low (I.Q. of 90 or lower).

6. A majority (52%) of the students were between 17 and 20 years old at first enrollment; less than 1% were under 17, and 8% were 40 and over.

7. Sixty-seven percent of the students were high-school graduates; about 5% had some college; 9% had no high school, and 19% were high school dropouts.

8. About 2½% of the sample were lost because the school records did not give their hours of class attendance. Most of them appeared to be early dropouts, and many of them may have failed to attend classes at all. Of the remainder, 7.7% attended zero hours, and another 17.1% attended less than 100 hours. If these three groups of short-term students are ignored, there are 1,247 students left (out of 1,701) with substantial class attendance. The median hours of instruction for this group is 703, 25% have less than 300 hours, and 21% have more than 1500 hours. Except for a group of practical nurses at 2100 hours, there does not appear to be a concentration of students at any point on the distribution; they are spread fairly evenly over the entire range.

Chapter IV

ANALYSIS OF WAGE DIFFERENCES AMONG THE VOCATIONALLY TRAINED AND NON-TRAINED

Wage Benefits

The income data used in this chapter were obtained from the questionnaire (Appendix B, form A) and are subject to several errors. When individuals report their income, they frequently round the figure to their advantage and generally exaggerate their earnings, as people frequently evaluate themselves in terms of their income. Then too, it is difficult to explain to an individual, particularly one with limited education, how to compute his average earned income on a questionnaire when one might have to consider net income before or after taxes, FICA and other company withholdings, overtime, incentive pay, tips or gratuities, and profits for self-employed persons. Even if the individual is accurate in reporting his average rate, we must know how many full-time weeks or hours he worked during a given year in order to compute his income.

Two questions were asked to obtain income. "Are you self-employed? (no ____yes____), if yes, how much do you earn (after business expenses) on the average per month?"; "If you work for someone else, how much do you earn on the average before any deductions, counting overtime and incentive pay if you usually get it? $__________per (hour, week, or month)." Hourly rates were multiplied by 40, and monthly rates by .231 to convert them into weekly rates for each individual.

Frequently it was difficult to separate part-time employment from full-time employment, and wage rates are of limited use under this situation. If an individual reported weekly earnings less than $64, we assumed that he must be working part-time, and increased reported earnings to $64 weekly, assuming the minimum wage for a forty hour week.

The only analysis made with these data was that of comparing the subpopulations of responding Experimental Subjects (attended AVTS for 300 or more hours prior to 1968, graduates of Tennessee high schools, born in 1943 or after, and were selected in the one-in-four randomly selected sample of all former AVTS students) with the Control Subjects (former high school classmates of the Experimental Group individually matched in high school attended, grade point average, I.Q., sex, rate, parents occupation, and curriculum).

Two sets of comparisons were made utilizing the above data. The first set deals with primary wage effects of AVTS training, while the second set of comparisons allows some measure of the secondary effects.

The primary wage effects of AVTS training are defined as the direct and immediate monetary return to AVTS training and may be measured by comparing "pure" Experimental Subjects (those without formal education or training other than high school prior to AVTS training) with "pure" Control Subjects (those cohorts reporting no formal education or training beyond high school). Thus, any wage differentials between the two Groups would be directly attributable to AVTS training, i.e., a negative or positive monetary return to training.

Table 13 shows rankings of the 59 pure matches by algebraic income differences and reveals the weekly income reported by the Experimental and Control members. Originally there were 73 pure matches, but 14 were disqualified from the analysis due to geographic mobility; only matches were accepted where both members were identical in migration.

It can be seen that the Experimental Subjects had a small average earnings advantage of $1.57 in reported wage rates for 1968. This would imply a small primary return directly to vocational training, if probable differences in participation rates between the two groups were not considered. The direct returns to AVTS training were even less than the returns reported by Corazzini.[38] It will be recalled that he found a positive wage differential of $160 annually in his study population using a similar method of measuring wages. Corazzini further reported that if the $160 differential were discounted at 5 percent, it would not equal the discounted training cost of $4,965 within the expected working life of the worker receiving the training.

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[38] Corazzini, op. cit.

Table 13

INCOME DIFFERENCES BETWEEN PURE PAIRS: PRIMARY EFFECTS

Subject	Reported Weekly Wage Rate Experimental Subject	Control Subject	Algebraic Difference	AVTS Attendance Period
175A	$138.45	$ 76.40	$62.05	66-67
129B	142.00	86.54	55.46	65-66
133A	192.00	142.00	50.00	64-65
104A	120.00	80.00	40.00	65-66
132B	140.40	107.50	32.90	64-65
218C	105.20	74.00	31.20	65-66
112B	115.38	92.00	23.38	64-66
304A	92.30	70.00	22.30	64-66
223A	85.38	64.00	21.38	66-67
325A	112.00	91.20	20.80	65-66
84A	85.60	66.92	18.68	65-65
8A	126.93	110.00	16.93	65-66
327A	80.00	64.00	16.00	66-67
146B	82.00	68.00	14.00	66-67
168A	94.40	81.00	13.40	66-67
137A	85.38	72.00	13.38	66-67
182A	92.31	79.20	13.11	66-67
314A	76.80	65.00	11.80	66-67
230A	74.42	64.00	10.42	65-66
231B	80.00	72.69	7.31	66-67
49B	71.00	64.00	7.00	65-66
91A	100.00	94.00	6.00	64-67
21A	70.00	64.00	6.00	65-66
176A	69.60	64.00	5.60	66-67
67E	69.24	64.00	5.24	67-67
56B	126.80	123.00	3.80	65-67

(Continued)

Table 13 (Continued)

Subject No.	Reported Weekly Wage Rate Experimental Subject	 Control Subject	Algebraic Difference	AVTS Attendance Period
328A	$ 70.00	$ 66.40	$ 3.60	66-67
4D	118.00	115.39	2.61	66-67
236E	66.00	64.00	2.00	66-67
20A	65.00	64.00	1.00	66-67
79A	65.00	64.00	1.00	65-67
237A	97.76	97.00	0.76	67-67
267A	69.24	69.23	0.01	66-66
23B	64.00	64.00	0.00	65-66
60A	64.00	64.00	0.00	67-67
42B	88.00	88.00	0.00	65-66
166C	64.00	64.00	0.00	66-67
159C	64.00	64.00	0.00	66-66
179B	64.00	72.00	–8.00	66-67
174C	66.93	75.00	–8.07	67-67
303E	129.00	120.00	–9.00	65-66
332A	64.00	74.00	–10.00	65-65
172C	74.80	64.00	–10.80	67-67
207B	69.24	80.40	–11.16	66-67
11A	143.40	154.85	–11.45	66-67
258A	73.60	88.40	–14.80	67-67
215B	83.07	100.00	–16.93	66-67
77A	80.00	99.00	–19.00	65-67
320A	66.00	85.00	–19.00	65-66
29A	76.40	97.62	–21.22	65-67
52B	64.00	87.69	–23.69	67-67
138A	64.00	88.00	–24.00	66-67

(Continued)

Table 13 (Continued)

	Reported Weekly Wage Rate			
Subject No.	Experimental Subject	Control Subject	Algebraic Difference	AVTS Attendance Period
183B	$ 90.00	$116.80	−26.80	65-66
92A	80.00	108.00	−28.00	65-66
118A	85.60	113.60	−28.00	65-66
135D	110.00	138.46	−28.46	65-67
305A	115.00	145.60	−30.60	66-67
319A	66.80	115.00	−48.20	67-67
199B	81.00	170.00	−89.00	67-67
MEAN	$ 89.31	$ 87.74	$ 1.57	

Table 14 shows these same pairs ranked by absolute income of the Experimental Subject and relates other characteristics of the Experimental Subject. It is important that we note here some income differences by sex and race. Table 15 shows these differences by isolating these characteristics and the average income as separate classes.

Table 15 shows that white males had a wage advantage of 6.26 percent, and that the female's wage differential of 1.81 percent and -7.17 percent for white and black females, respectively, served to dampen aggregate gains in the whole population. Although economic discrimination against women and Negroes is obvious, it is difficult to explain from these data why trained women and more particularly Negro women were at an earning disadvantage with their untrained cohorts. Although any conclusion must be highly tentative at this time, a reasonable explanation is that women, particularly black women, were trained for low wage occupations relative to the other occupational alternatives available to their cohorts.

If we consider, however, a more inclusive return to vocational training, ''secondary effects,'' the picture is considerably brighter. To measure secondary effects, the list of pure matches was expanded to include Experimental Subjects who were contaminated with later training or education and Control Subjects who were likewise contaminated. Rejected from the study population, however, was any subject who went directly from high school to college and subjects who reported they were not members of the labor force, i.e., were not working or seeking work. This tended to be a bias against the Experimental Group since they should, theoretically at least, have higher labor force participation rates.

Table 14

EARNINGS AND OTHER CHARACTERISTICS OF PURE PAIRS: PRIMARY EFFECTS

Subject Number[a]	Reported Weekly Wage Rate		Program of Instruction	Hours of Instruction	Sex	Occupational Mobility[b]	Relatedness[c]	IQ[d]	High School Rank[e]
	Experimental Subject	Control Subject							
133A	$192.00	$142.00	Welding	1007	M	1	R	112	62
11A	143.40	154.85	Welding	988	M	--	R	88	35
129B	142.00	86.54	Welding	1804	M	--	R	103*	36
132B	140.40	107.50	Machine Shop	2080	M	1	R	87	26
175A	138.45	76.40	Machine Shop	1000	M	1	NTR	102	94
303E	129.00	120.00	Drafting	1574	M	1	NTR	99	16
8A	126.93	110.00	Machine Shop	1252	M	--	M	107	39
56B	126.80	123.00	Machine Shop	3040	M	--	R	93	15
104A	120.00	80.00	Drafting	1284	M	--	R	89	16
4D	118.00	115.39	Welding	1001	M	--	NTR	98	21
112B	115.38	92.00	Drafting	2355	M	--	R	94	14
305A	115.00	145.60	Auto Mechanics	1561	M	--	M	94	8
325A	112.00	91.20	Drafting	1153	M	--	NTR	129	62
135D	110.00	138.46	Refrigeration	2206	M	1	R	87	60
218C	105.20	74.00	Lic. Prac. Nurse	2123	F	--	R	89	82
91A	100.00	94.00	Machine Shop	2856	M	--	NTR	90	15
237A	97.76	97.00	Off. Occupations	348	F	--	NTR	100	98
168A	94.40	81.00	Off. Occupations	874	F	--	R	117	79
182A	92.31	79.20	Lic. Prac. Nurse	2123	F	--	R	112	44
304A	92.30	70.00	Machine Shop	1615	M	--	U	100	43
183B	90.00	116.80	Refrigeration	420	M	1	NTR	111	8
42B	88.00	88.00	Auto Mechanic	1080	M	1	NTR	90	38
84A	85.60	66.92	Small Gas Engine	786	M	--	NTR	111	Unknown
118A	85.60	113.60	Small Gas Engine	832	M	--	NTR	90	19
137A	85.38	72.00	Off. Occupations	1155	F	--	R	117	100
223A	85.38	64.00	Lic. Prac. Nurse	2123	F	--	R	110	83
215B	83.07	100.00	Lic. Prac. Nurse	2123	F	--	R	96	32
146B	82.00	68.00	Off. Occupations	922	F	--	R	96	66
199B	81.00	170.00	Lic. Prac. Nurse	440	F	--	NTR	93*	46

(Continued)

Table 14 (Continued)

Subject Number[a]	Reported Weekly Wage Rate: Experimental Subject	Reported Weekly Wage Rate: Control Subject	Program of Instruction	Hours of Instruction	Sex	Occupational Mobility[b]	Relatedness[c]	IQ[d]	High School Rank[e]
77A	$ 80.00	$ 99.00	Electrical	2856	M	--	R	94	45
92A	80.00	108.00	Auto Mechanics	1363	M	1	R	90	15
151B	80.00	65.00	Off. Occupations	775	F	--	R	109	Unknown
231B	80.00	72.69	Off. Occupations	375	F	--	R	109	40
314A	76.80	65.00	Auto Mechanics	1459	M	--	NTR	102	60
29A	76.40	97.62	Auto Mechanics	2514	M	1	M	103*	36
172C	74.80	64.00	Drafting	394	M	--	NTR	Unknown	31
230A	74.42	64.00	Off. Occupations	560	F	--	R	121*	83
258A	73.60	88.40	Off. Occupations	892	F	--	NTR	104	53
49B	71.00	64.00	Off. Occupations	848	F	--	NTR	100	49
328A	70.00	66.40	Off. Occupations	1061	F	--	R	100	94
21A	70.00	64.00	Off. Occupations	366	F	--	R	Unknown	60
176A	69.60	64.00	Off. Occupations	1211	F	--	R	Unknown	Unknown
67E	69.24	64.00	Operat. Rm. Tech	1480	F	--	R	Unknown	90
267A	69.24	69.23	Off. Occupations	336	F	--	R	107	33
207B	69.24	80.40	Lic. Prac. Nurse	2123	F	--	R	111	79
174C	66.93	75.00	Off. Occupations	574	F	--	R	108	85
319A	66.80	115.00	Off. Occupations	439	F	--	NTR	110	63
320A	66.00	85.00	Off. Occupations	938	F	--	NTR	108	9
236E	66.00	64.00	Lic. Prac. Nurse	2123	F	1	U	93	Unknown
79A	65.00	64.00	Machine Shop	859	M	--	U	84	14
20A	65.00	64.00	Off. Occupations	1469	F	--	R	91	Unknown
23B	64.00	64.00	Off. Occupations	1248	F	1	U	88	69
52B	64.00	87.69	Off. Occupations	403	F	1	R	122	86
60A	64.00	64.00	Operat. Rm. Tech	1480	F	--	R	113	24
138A	64.00	88.00	Welding	1557	M	1	NTR	87	61
159C	64.00	64.00	Off. Occupations	312	F	--	NTR	114	72
179B	64.00	72.00	Off. Occupations	701	F	--	NTR	115	91

(Continued)

Table 14 (Continued)

Subject Number[a]	Reported Weekly Wage Rate: Experimental Subject	Reported Weekly Wage Rate: Control Subject	Program of Instruction	Hours of Instruction	Sex	Occupational Mobility[b]	Relatedness[c]	IQ[d]	High School Rank[e]
332A	$ 64.00	$ 74.00	Off. Occupations	729	F	--	NTR	115	91
166C	64.00	64.00	Off. Occupations	713	F	1	NTR	119	96

[a] Negro subjects (pairs) are underlined.

[b] Occupational mobility for each Experimental Subject that reported having more than one occupation in 1968. No mobility is recorded as (--), and one or more changes are recorded as (1).

[c] Relatedness was determined for each Experimental Subject by comparing type of AVTS training with present occupation. Relatedness is recorded as (R), moderate relatedness as (M), unrelatedness as (U), no training required for an occupation as (NTR).

[d] IQ was recorded for Experimental Subjects from high school records. The measuring instrument varied but the most frequent ones used were Lorge-Thorndyke, California Mental Maturity, and The Otis. An asterisk by a score indicates the G component score from a GATB received at time of entrance at AVTS used in the absence of a recorded IQ.

[e] Rank in graduating high school class of Experimental Subject was obtained from high school records and recorded as a percentile, i.e., the number may be interpreted as revealing the percentage of classmates having a lower grade average and if subtracted from 100 reveals how many classmates had a higher grade average.

Table 15

ANALYSIS OF PRIMARY EARNING DIFFERENTIALS

	Reported Weekly Wage Rate		
	Experimental Subjects	Control Subjects	Difference as Percent of Control Subjects
27 Pairs: White Males	$106.96	$100.66	+6.26%
25 Pairs: White Females	71.76	73.08	−1.81%
7 Pairs: Negro Females	83.95	90.43	−7.17%
59 Pairs: Total	89.31	87.76	+1.77%

It will be recalled from an earlier discussion that secondary effects of AVTS training include any sequential and indirect advantages that accrue to the individual as a result of AVTS training, e.g., higher eligibility and acceptance into apprenticeship programs and company training programs that lead to higher paying jobs and seeking further training by correspondence courses, private vocational schools and colleges as a result of a favorable training experience at AVTS, etc.

A different set of random matches was drawn accepting secondary contamination as explained above and is presented in Table 16. The range of income differences for the Experimental Subjects was from +$126.00 per week to -$88.00 per week. On the average the Experimental Subjects had a weekly wage advantage of $7.02 (7.79% higher). This, however, reflects only the gross difference between the two groups and contains several opposite relationships that mutually tend to cancel each other.

Table 17 reveals some of the individual relationships within these data by showing for each pair (Experimental and Control Subject) race, sex, and reported weekly wage rate, and by showing (for the Experimental Subject only) the program studied in AVTS, hours of instruction received, occupational mobility during 1968, relatedness of AVTS training to last 1968 occupation, I.Q., and rank in their high school graduation class. The wage trends of some of these characteristics will be shown in later tables and discussed specifically.

Table 17, indicating rank by absolute income of the Experimental Subjects, contains pairs of 52 males and 49 females. Fourteen of the female pairs are Negroes. It is interesting to note that males led in absolute wages and that these high-income males tend to be bright (but underachievers in high school) and employed in metal-working occupations. All Experimental males combined had an average I.Q. of 100.4, while the top nine in income had an average I.Q. of 106.2. Although the average female Experimental Subject was considerably brighter than the male, having an average I.Q. of 102.7, she tended to be relegated to low-wage occupations. The male Experimental Subjects averaged $113.84 per week, while their female counterparts averaged only $79.49 per week. Even when number of hours of instruction is considered, males earned 43.2 percent more than females but had only 26.1 percent more hours of instruction. The obvious interpretation of these data is that females were trained for low-wage jobs relative to males. But this appears to be in keeping with pervasive cultural discrimination against women working at high-wage jobs.

Table 16

INCOME DIFFERENCES BETWEEN UNPURE PAIRS: SECONDARY EFFECTS

Subject Number[a]	Reported Weekly Wage Rate: Experimental Subject	Reported Weekly Wage Rate: Control Subject	Experimental Contamination[b]	Control Contamination	Algebraic Difference
324	$226.00	$100.00	3	1	+126.00
64	157.50	64.00	4	4	+ 93.50
18	150.00	64.00	1	4	+ 86.00
202	156.00	92.02	2	3	+ 63.98
216	126.00	64.00	1	4	+ 62.00
175	138.45	77.40	1	1	+ 61.05
298	150.00	100.00	3	1	+ 50.00
133	192.00	142.00	1	1	+ 50.00
6	125.00	78.00	6	1	+ 47.00
228	110.00	64.00	1	5	+ 46.00
270	131.25	90.00	1	3	+ 41.25
162	107.20	66.00	3	1	+ 41.20
104	120.00	80.00	1	1	+ 40.00
129	142.00	103.84	1	3	+ 38.16
95	175.00	140.38	6	5	+ 34.62
132	140.40	107.50	1	1	+ 32.90
294	154.00	126.92	1	6	+ 27.08
254	92.31	66.00	3	4	+ 26.31
38	91.60	66.00	3	1	+ 25.60
53	88.00	64.00	6	1	+ 24.00
112	115.38	92.00	1	1	+ 23.38
304	92.30	70.00	1	1	+ 22.30
223	85.38	64.00	1	2	+ 21.38
325	112.00	91.20	1	1	+ 20.80
178	88.40	69.23	3	1	+ 19.17
84	85.60	66.92	1	1	+ 18.68
335	157.00	138.53	6	1	+ 18.47
8	126.93	110.00	1	1	+ 16.93
327	80.00	64.00	1	1	+ 16.00

(Continued)

Table 16 (Continued)

Subject Number[a]	Reported Weekly Wage Rate Experimental Subject	 Control Subject	Experimental Contamination[b]	Control Contamination	Algebraic Difference
231	$ 80.00	$ 64.00	1	1	+ 16.00
151	80.00	65.00	1	4	+ 15.00
63	78.85	64.00	1	5	+ 14.85
146	82.00	68.00	1	2	+ 14.00
168	94.40	81.00	1	1	+ 13.40
137	85.38	72.00	1	1	+ 13.38
182	92.31	79.20	2	1	+ 13.11
314	76.80	65.00	1	1	+ 11.80
184	103.86	92.30	1	6	+ 11.56
172	74.80	64.00	1	1	+ 10.80
230	74.42	64.00	1	1	+ 10.42
214	88.62	78.46	4	1	+ 10.16
245	73.60	64.00	4	1	+ 9.60
157	76.14	66.80	1	4	+ 9.34
21	70.00	64.00	1	1	+ 6.00
91	100.00	94.00	1	2	+ 6.00
176	69.60	64.00	1	1	+ 5.60
67	69.24	64.00	1	1	+ 5.24
56	126.80	123.00	1	1	+ 3.80
328	70.00	66.40	1	1	+ 3.60
4	118.00	115.39	1	2	+ 2.61
277	96.00	94.00	1	4	+ 2.00
167	66.00	64.00	1	4	+ 2.00
218	105.00	103.20	1	5	+ 1.80
20	65.00	64.00	1	1	+ 1.00
79	65.00	64.00	1	1	+ 1.00
237	97.76	97.00	1	2	+ 0.76
278	88.59	88.40	1	3	+ 0.19
267	69.24	69.23	1	1	+ 0.01

(Continued)

Table 16 (Continued)

Subject Number[a]	Reported Weekly Wage Rate		Experimental Contamination[b]	Control Contamination	Algebraic Difference
	Experimental Subject	Control Subject			
23	$ 64.00	$ 64.00	1	1	+ 0.00
60	64.00	64.00	1	1	+ 0.00
179	64.00	64.00	1	3	+ 0.00
244	64.00	64.00	1	1	+ 0.00
42	88.00	88.00	1	1	+ 0.00
159	64.00	64.00	1	1	+ 0.00
166	64.00	64.00	1	4	+ 0.00
303	129.00	131.53	1	6	− 2.53
288	146.00	150.00	1	7	− 4.00
59	64.00	68.08	2	1	− 4.08
268	94.00	100.00	1	1	− 6.00
128	98.00	105.20	3	5	− 7.20
68	98.82	107.20	2	3	− 8.38
332	64.00	74.00	1	1	−10.00
100	100.00	110.77	1	3	−10.76
207	69.24	80.40	1	1	−11.16
11	143.40	154.85	1	1	−11.45
258	73.60	88.40	1	1	−14.80
301	85.00	95.60	3	5	−15.60
194	83.07	100.00	1	4	−16.93
215	83.07	100.00	1	1	−16.93
77	80.00	99.00	1	1	−19.00
320	66.00	85.00	1	1	−19.00
174	66.93	86.00	1	6	−19.07
29	76.40	97.62	1	1	−21.22
236	66.00	88.40	2	7	−22.40
52	64.00	87.69	1	1	−23.69
49	71.00	95.00	1	5	−24.00
138	64.00	88.00	1	1	−24.00

(Continued)

Table 16 (Continued)

Subject Number[a]	Reported Weekly Wage Rate Experimental Subject	 Control Subject	Experimental Contamination[b]	Control Contamination	Algebraic Difference
183	$ 90.00	$116.80	1	1	-26.80
145	75.00	102.00	5	1	-27.00
92	80.00	108.00	1	1	-28.00
118	85.60	113.60	1	1	-28.00
141	90.00	118.00	1	7	-28.00
135	110.00	138.46	1	1	-28.46
121	86.00	115.38	1	3	-29.38
305	115.00	145.60	1	1	-30.60
204	94.62	126.92	4	4	-32.30
36	86.00	120.00	3	1	-34.00
113	90.00	136.00	1	4	-46.00
319	66.80	115.00	1	1	-48.20
143	70.00	154.00	1	4	-84.00
199	81.00	170.00	1	2	-88.00

[a] Negro subjects (pairs) are underlined.

[b] Contamination from other than AVTS training for Experimental Subjects and other than high school for Control Subjects is coded as: (1) = no contamination; (2) = less than 1000 hours of training not related to their occupation; (3) = less than 1000 hours of training directly related to their occupation; (4) = at least one year of college; (5) = 1000 hours or more of training not related to their occupation; (6) = 1000 hours or more of training directly related to their occupation; and (7) = over one year of college in addition to some other kind of contamination as coded above.

Table 17

EARNINGS AND OTHER CHARACTERISTICS OF UNPURE PAIRS: SECONDARY EFFECTS

Subject Number[a]	Reported Weekly Wage Rate		Program of Instruction	Hours of Instruction	Sex	Occupational Mobility[b]	Relatedness[c]	IQ[d]	High School Rank[e]
	Experimental Subject	Control Subject							
324B	$226.00	$100.00	Drafting	1130	M	--	U	99	19
133A	192.00	142.00	Welding	1007	M	1	R	112	62
95B	175.00	140.38	Machine Shop	1666	M	--	R	100	38
64C	157.50	64.00	Electrical	1276	M	--	U	112	11
335B	157.00	138.53	Machine Shop	585	M	--	U	120	8
202B	156.00	92.02	Off. Occupations	1177	F	--	R	104	97
294B	154.00	126.92	Electrical	861	M	--	R	95	28
143B	154.00	70.00	Machine Shop	2020	M	--	R	112	39
18B	150.00	64.00	Sheet Metal	354	M	1	R	103	61
298B	150.00	100.00	Machine Shop	2222	M	--	R	103*	22
288C	146.00	150.00	Welding	690	M	--	NTR	88	37
11A	143.40	154.85	Welding	988	M	--	R	88*	35
129A	142.00	103.84	Welding	1804	M	--	R	103*	36
132B	140.40	107.50	Machine Shop	2080	M	1	R	87	26
175A	138.45	77.40	Machine Shop	1000	M	1	NTR	102	94
270A	131.25	90.00	Small Gas Engine	582	M	1	U	94	Unknown
303B	129.00	131.53	Drafting	1574	M	1	NTR	99	16
8A	126.93	110.00	Machine Shop	1252	M	--	M	107	39
56B	126.80	123.00	Machine Shop	3040	M	--	R	93	15
216A	126.00	64.00	Off. Occupations	1745	F	--	R	88	58
6A	125.00	78.00	Electrical	2268	M	--	R	109	56
104A	120.00	80.00	Drafting	1284	M	--	R	89	16
4D	118.00	115.39	Welding	1001	M	--	NTR	98	21
112B	115.38	92.00	Drafting	2355	M	--	R	94	14
305A	115.00	145.60	Auto Mechanics	1561	M	--	M	94	8
325A	112.00	91.20	Drafting	1153	M	--	NTR	129	62
135D	110.00	138.46	Refrigeration	2206	M	1	R	87	60
228C	110.00	64.00	C. L. A.[f]	2080	F	1	R	125	92
162B	107.20	66.00	Welding	1290	M	--	R	90	37

(Continued)

Table 17 (Continued)

Subject Number[a]	Reported Weekly Wage Rate Experimental Subject	 Control Subject	Program of Instruction	Hours of Instruction	Sex	Occupational Mobility[b]	Relatedness[c]	IQ[d]	High School Rank[e]
218A	$105.00	$103.20	L.P.N.[g]	2123	F	--	R	89	82
184A	103.86	92.30	C.L.A.	2000	F	--	R	107	57
91A	100.00	94.00	Machine Shop	2856	M	--	NTR	90	15
100C	100.00	110.77	Auto Mechanic	468	M	--	NTR	100	54
68B	98.82	107.20	Electrical	546	M	1	NTR	110*	49
237A	97.76	97.00	Off. Occupations	348	F	--	NTR	100	98
128A	98.00	105.20	Drafting	2460	M	--	R	100	41
277A	96.00	94.00	Drafting	2006	M	--	R	115	45
204C	94.62	126.92	Drafting	923	M	--	R	116	69
168A	94.40	81.00	Off. Occupations	874	F	--	R	117	79
268A	94.00	100.00	Drafting	318	M	1	U	103	56
254A	92.31	66.00	Electrical	918	M	--	M	113	96
182A	92.31	79.20	L. P. N.	2123	F	--	R	112	44
304A	92.30	70.00	Machine Shop	1615	M	--	U	100	43
38A	91.60	66.00	Off. Occupations	539	F	--	R	94	80
183B	90.00	116.80	Refrigeration	420	M	1	NTR	111	8
141C	90.00	118.00	Auto Mechanic	1657	M	--	R	Unknown	26
113A	90.00	136.00	Drafting	2249	M	1	R	Unknown	Unknown
214A	88.62	78.46	C. L. A.	2080	F	--	R	92	17
278C	88.59	88.40	Off. Occupations	1015	F	1	NTR	95	90
178A	88.40	69.23	Off. Occupations	956	F	--	R	108	63
42B	88.00	88.00	Auto Mechanic	1080	M	1	NTR	90	38
53C	88.00	64.00	Auto Mechanic	2720	M	1	M	91	42
36B	86.00	120.00	Drafting	397	M	1	M	111	32
121B	86.00	115.38	Electrical	302	M	--	M	Unknown	26
84A	85.60	66.92	Small Gas Engine	786	M	--	NTR	111	Unknown
118A	85.60	113.60	Small Gas Engine	832	M	--	NTR	90	19
137A	85.38	72.00	Off. Occupations	1155	F	--	R	117	100
223A	85.38	64.00	L. P. N.	2123	F	--	R	110	83
301A	85.00	95.60	Auto Mechanic	951	M	--	R	Unknown	14

(Continued)

Table 17 (Continued)

Subject Number[a]	Reported Weekly Wage Rate Experimental Subject	 Control Subject	Program of Instruction	Hours of Instruction	Sex	Occupational Mobility[b]	Relatedness[c]	IQ[d]	High School Rank[e]
194B	$ 83.07	$ 100.00	L. P. N.	2123	F	--	R	101*	92
215B	83.07	100.00	L. P. N.	2123	F	--	R	96	32
146B	82.00	68.00	Off. Occupations	922	F	--	R	96	66
199B	81.00	170.00	L. P. N.	440	F	--	NTR	93*	46
77A	80.00	99.00	Electrical	2856	M	--	R	94	45
92A	80.00	108.00	Auto Mechanic	1363	M	1	R	90	15
151B	80.00	65.00	Off. Occupations	775	F	--	R	109	Unknown
231A	80.00	64.00	Off. Occupations	375	F	--	R	109	40
327A	80.00	64.00	Off. Occupations	527	F	--	R	119	92
63A	78.85	64.00	Off. Occupations	388	F	--	R	118	71
314A	76.80	65.00	Auto Mechanic	1459	M	--	NTR	102	60
29A	76.40	97.62	Auto Mechanic	2514	M	--	M	103*	36
157A	76.14	66.80	Off. Occupations	860	F	--	R	112	71
145A	75.00	102.00	Off. Occupations	1252	F	--	R	106	47
172C	74.80	64.00	Drafting	394	M	--	NTR	Unknown	31
230A	74.42	64.00	Off. Occupations	560	F	--	R	121*	83
245D	73.60	64.00	Off. Occupations	435	F	--	NTR	86*	65
258A	73.60	88.40	Off. Occupations	892	F	--	NTR	104	53
49A	71.00	95.00	Off. Occupations	848	F	--	NTR	100	49
328A	70.00	66.40	Off. Occupations	1061	F	--	R	100	94
21A	70.00	64.00	Off. Occupations	366	F	--	R	Unknown	60
176A	69.60	64.00	Off. Occupations	1211	F	--	R	Unknown	Unknown
207B	69.24	80.40	L. P. N.	2123	F	--	R	111	79
67E	69.24	64.00	Operat. Rm. Tech	1480	F	--	R	Unknown	90
267A	69.24	69.23	Off. Occupations	336	F	--	R	107	33
174A	66.93	86.00	Off. Occupations	574	F	--	R	108	85
319A	66.80	115.00	Off. Occupations	439	F	--	NTR	110	63
236B	66.00	88.40	L. P. N.	2123	F	1	U	93	Unknown
320A	66.00	85.00	Off. Occupations	938	F	--	NTR	108	9

(Continued)

Table 17 (Continued)

Subject Number[a]	Reported Weekly Wage Rate		Program of Instruction	Hours of Instruction	Sex	Occupational Mobility[b]	Relatedness[c]	IQ[d]	High School Rank[e]
	Experimental Subject	Control Subject							
167A	$ 66.00	$ 64.00	Off. Occupations	1241	F	1	R	102	45
20A	65.00	64.00	Off. Occupations	1469	F	--	R	91	Unknown
79A	65.00	64.00	Machine Shop	859	M	--	U	84	14
23B	64.00	64.00	Off. Occupations	1248	F	1	U	88	69
52B	64.00	87.69	Off. Occupations	403	F	1	R	122	86
59E	64.00	68.08	Operat. Rm. Tech	1480	F	--	R	100	68
60A	64.00	64.00	Operat. Rm. Tech	1480	F	1	R	113	24
138A	64.00	88.00	Welding	1557	M	1	NTR	87	61
159C	64.00	64.00	Off. Occupations	312	F	--	NTR	114	72
179A	64.00	64.00	Off. Occupations	701	F	--	NTR	109	30
244C	64.00	64.00	Off. Occupations	306	F	1	Unknown	89	32
332A	64.00	74.00	Off. Occupations	729	F	--	R	115	91
166A	64.00	64.00	Off. Occupations	713	F	1	NTR	119	96

Number Males : 52 Mean IQ: Experimental Males : 100.4; Experimental Females : 102.7
Number Females : 49 Mean Wage: Experimental Males : $113.84; Experimental Females : $79.49
Mean Wages for Experimental Subjects : $97.17 Mean Hours of Instruction Received: Experimental Males: 1380 hours
Mean Wages for Control Subjects : $90.15 Mean Hours of Instruction Received: Experimental Females: 1094 hours

[a] Negro subjects (pairs) are underlined.

[b] Occupational mobility for each Experimental Subject that reported having more than one occupation in 1968. No mobility is recorded as (--) and, one or more changes are recorded as (1).

[c] Relatedness was determined for each Experimental Subject by comparing type of AVTS training with present occupation. Relatedness is recorded as (R), moderate relatedness as (M), unrelatedness as (U), no training required for an occupation as (NTR).

[d] IQ was recorded for Experimental Subjects from high school records. The measuring instrument varied but the most frequent ones used were Lorge- Thorndyke, California Mental Maturity, and The Otis. An asterisk by a score indicates the G component score from a GATB received at time of entrance at AVTS used in the absence of a recorded IQ.

[e] Rank in graduating high school of Experimental Subject was obtained from high school records and recorded as a percentile, i.e., the number may be interpreted as revealing the percentage of classmates having a lower grade average and if subtracted from 100 reveals how many classmates had a higher grade average.

[f] Certified Lab Assistant.

[g] Licensed Practical Nurse.

The data in Table 18 show the difference in average weekly earnings for unpure types as a result of primary and secondary effects of AVTS training. The results are in the same direction as those in Table 15 that revealed sex and race differences in income, except that here white females are at an earning disadvantage. Female Negro Experimental Subjects earned on the average $15.75 per week more than their white counterparts and had a $2.11 earning advantage over their Control Subjects. This difference between Tables 15 and 18 may be attributable to sampling error, but since the comparison in Table 18 entails 17 more matched pairs (seven more Negro pairs and ten more white pairs), it is more probable that it reflects the true trend. The results seem to indicate that both the Negro Experimental and Control Subjects chose occupations less susceptible to female and race discrimination.

Again, the white male Experimental Subjects took the day with an 11.8 percent earning advantage over their Control Subjects that was attributable to the primary and secondary effects of AVTS training. The Experimental Subjects enjoyed a sizable average earning advantage of $12.02 per week over their cohorts.

It was stated earlier in this study that geographic mobility was controlled. In both the pure and unpure comparisons, only matches were accepted where both the Experimental and Control Subject had migrated[39] or where neither had migrated. This maneuver was performed in order to avoid capitalizing mobility and spuriously accepting its rightful returns as a consequence to either AVTS training or non-training. Table 19 shows the monetary effects of mobility on AVTS training. Under conditions of mobility, the returns to AVTS training were maximized, revealing the most extreme income advantage to the Experimental Subjects, and allowed them their highest absolute average income.

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[39] Geographic mobility was defined as present residence in a county not contiguous to the county containing the high school from which the subject was graduated.

Table 18

ANALYSIS OF SECONDARY EARNING DIFFERENTIALS

	Reported Weekly Wage Rates		
	Experimental Subjects	Control Subjects	Difference as Percent of Control Subjects
52 Pairs: White Males	$113.84	$101.82	+11.81%
49 Pairs: Females	79.49	77.76	+ 2.22%
14 Pairs: Negro Females	90.74	87.50	+ 3.70%
35 Pairs: White Females	74.99	73.86	+ 1.53%
101 Pairs: Total	97.17	90.15	+ 7.79%

Table 19 reflects a high degree of continuity with economic theory. Theory holds that there will be labor mobility when a geographic wage disparity exists as workers move geographically to obtain higher paying jobs, assuming knowledge of the labor market and a willingness to maximize income. This trend apparently existed as evidenced by the data examined. It can be seen that when the Experimental Subjects were immobile and the Control Subjects mobile, the Control Subjects had an earnings advantage of 7.8 percent. Conversely, under the opposite conditions the Experimental Subjects had an income advantage averaging 10.5 percent.

Although not shown in this table, a migration rate was computed from records of all responding Experimental Subjects and a corresponding group of their randomly selected Control Subjects. The group consisted of 125 pairs of matches.[40] It was found that the Control Subjects had a higher migration rate. Twenty-six of the Control Subjects had moved since graduation from high school, while only 16 Experimental Subjects had done so, resulting in a rate of 22.6 percent for the Controls and 12.8 percent for the Experimentals. It appears that those receiving AVTS training have a greater opportunity of finding local jobs. Local jobs may not be the solution to Tennessee's low income problem, although they do tend to stem the flow of out-migration. The AVTS trained tend to stay home but at no small reduction of income. This can be seen in Table 19. Immobile Experimental Subjects lost on the average $27.45 in weekly income by remaining immobile, and even averaged $8.78 behind the untrained but mobile Control Subjects. The reader is warned that the differences in income between mobility and immobility groups shown in Table 19 are not necessarily pure effects, since the brighter, more competent or more employable pairs of matches could tend to be more mobile leaving a lesser quality behind. The result of this analysis of mobility is that it indicates a trend toward a positive relationship between mobility and income.

The last variable to be considered in its relationship to AVTS training and income is program of instruction. Income differences at a given time may be explained by regional variations, industry variations, occupational variations, sex, race, and other individual differences. Unfortunately, these factors are not always mutually exclusive with only one or two of the factors establishing level of income. We wish to examine here income level by type of occupational training, realizing full well that sex, industry, and individual characteristics tend to contaminate the occupational categories, and that any income differences associated with these categories may not be totally attributable to the type of training. Nevertheless, we shall proceed along this path of establishing different rates of return to the various AVTS training programs, remaining cognizant of the methodological shortcomings.

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[40] From this group were rejected 21 pairs for unmatched mobility and three pairs for insufficient wage data. The remaining 121 pairs were used as one of the two main samples.

Table 19

THE INFLUENCE OF GEOGRAPHIC MOBILITY ON SECONDARY EARNING DIFFERENTIALS[a]

		Reported Weekly Wage Rate		
		Experimental Subjects	Control Subjects	Difference as Percent of Control Subjects
101	Pairs: Mobile and Immobile	$ 97.17	$ 90.15	+ 7.8
7	Pairs: Both Mobile	122.72	104.05	+17.9
94	Pairs: Both Immobile	95.27	89.11	+ 6.9
11	Discarded Pairs: Experimental Immobile but Controls Mobile	103.68	112.45	- 7.8
10	Discarded Pairs: Experimental Mobile but Controls Immobile	79.51	71.93	+10.5

[a] Geographic mobility was defined as present residence in a county not contiguous to the county containing the high school from which the subject was graduated.

Table 20 shows variations in average weekly income for 10 classifications of AVTS training programs. A wide range is immediately obvious in both average occupational program earnings and income advantage over cohorts. Former AVTS students that studied machine shop had the highest average absolute income ($129.63 per week) and the highest income advantage over their matched Control Subjects ($30.10). The occupational category of electronics and electricity was next in magnitude in both absolute income and relative income.

On the opposite end of the scale the girls who studied office occupations were absolutely in the lowest earning position but were 5.2 percent better off than their cohorts. The students receiving Licensed Practical Nurse training had the greatest loss relative to their Control Subjects (-15.3 percent) and were second from last in average absolute income ($83.13 per week). The only other category of losers was auto mechanics, the only male category earning on the average less than $100 per week. These students were on the average 10.5 percent worse off than their matched Control Subjects.

Non-Wage Benefits

Other economic benefits of vocational education such as increased employability have been neglected in most previous studies. Therefore, included in the questionnaire was a section on labor force participation, unemployment, and occupational changes. Thus, it was possible to compare the employment experiences of the former AVTS students with their untrained cohorts. The analysis of these data and conclusions are the subject of an article by the authors in the Industrial and Labor Relations Review.[41] Only a summary of the findings is reported here; the reader is referred to the cited article for a more complete treatment of the effect of vocational training on employability.

The analysis led to the conclusion that vocational training enhances labor force participation, reduces unemployment, and increases occupational mobility, in addition to its known effect of raising income. This conclusion was derived from an analysis of 58 "pure" pairs matched in terms of race, I.Q., sex, rank in high school class, type of school program, and labor market area.[42]

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[41] Bowlby and Schriver, op. cit.

[42] Ibid.

Table 20

SECONDARY EARNING DIFFERENTIALS AMONG CATEGORIES OF INSTRUCTIONAL PROGRAMS

		Reported Weekly Wage Rate		
		Experimental Subjects	Control Subjects	Difference as Percent of Control Subjects
101	Pairs	$ 97.17	$ 90.15	+ 7.8
35	Pairs Office Occupations	78.01	74.12	+ 5.2
12	Pairs Drafting	111.32	103.40	+ 7.7
11	Pairs Machine Shop	129.63	99.53	+30.2
9	Pairs Auto Mechanics	88.80	99.18	−10.5
8	Pairs LPN[a]	83.13	98.15	−15.3
7	Pairs Welding	130.37	117.15	+11.3
7	Pairs Electrical	113.38	93.79	+20.9
6	Pairs CLA[b] and ORT[c]	83.29	71.81	+16.0
6	Pairs Miscellaneous (3 Small Gas Engine, 2 Refrigeration and 1 Sheet Metal)	108.74	98.30	+10.6

[a] Licensed Practical Nurse.

[b] Certified Lab Assistant.

[c] Operating Room Technician.

Summary

The labor force experience records examined in this investigation indicate that there was a definite average earnings advantage, at least in the short-run, to most categories of AVTS training. This was determined by comparing a sample of former AVTS students with a control group of their high school cohorts matched as closely as possible except that the latter did not attend AVTS (or enter college immediately after graduation from high school). This procedure allowed us to guess with some scientific precision what would most likely have happened to the former AVTS students had they not taken their training. The differences in the labor force experiences of these two groups is thus attributable to primary and secondary effects of AVTS training.

It may be profoundly important to note and describe briefly the labor market circumstances surrounding the time period of this investigation. The reader can then more realistically interpret the findings. The data were collected during February and March 1969, but referred generally to the 1964-1968 period, depending upon date of AVTS entrance, with emphasis upon 1968 experiences. Two important but not unrelated events mark this period: (1) an increasing national commitment to military mobilization with conscription that had added the spectre of draft eligibility to the employment scene; and (2) the nation was undergoing an unprecedented period of growth that was accompanied by growth in labor force participation and wages and a decline in unemployment.

These conditions could strongly affect relationships found in this study. AVTS students received draft deferments, while their cohorts were more likely to be eligible, reducing the latter's employability until they became veterans or were declared ineligible. The group containing the subjects most immune from the draft would have a considerable earnings advantage over the draft-prone group. The other mitigating circumstance was the sustained level of high employment during the period under study. There is evidence that the economy in this cycle gobbles up labor rather indiscriminately, but during recessions those with less training and skills are unemployed first. If this is the case, AVTS training advantages could be greater during stable or declining periods.

Difference in Labor Force Experiences

1. The primary wage effects of AVTS training resulted in a $1.57 per week advantage directly attributable to AVTS training.

2. The combined secondary wage effects of AVTS training were greater, resulting in an average advantage of $7.02 per week.

3. The secondary wage effects of AVTS training were maximized among those former students who were males, those who migrated, and those who received substantial hours of instruction in machine shop, welding, and electricity-electronics.

4. AVTS training resulted in higher labor force participation, lower unemployment, and greater occupational mobility.

Chapter V

INTERNAL ANALYSIS OF INCOME (SOCIAL SECURITY EARNINGS) AMONG THE VOCATIONALLY TRAINED

The past analysis of AVTS training was based upon income estimates reported in questionnaires by former AVTS students and their cohorts. The reliability of this method of determining income is questionable since possible reporting errors are numerous. The subject may bias his estimate negatively if he suspects the IRS may become aware of his answer, or positively, to promote self-esteem. Also, recall of exact amounts is unreliable, particularly when coupled with the type of income in which the authors were interested: total income earned from a job before taxes and including overtime (minus costs, if self-employed).

The income problem was solved at least partially by relying on the individual earned income records of the Social Security Administration. All employed persons covered by Social Security (approximately 98 percent of the study population) pay a fixed tax on the first $6,600 of earned income, and the amount of the total income is recorded quarterly under the individual's account number at the Social Security Administration. As long as an individual earned less than $6,600 per year, his earned income by quarters could be obtained directly from his Social Security record. For a few students, whose annual income exceeded the $6,600 limit, annual earnings were extimated by assuming level earnings throughout the year. However, almost all of the study population earned less than the base annually, and their total recorded income was determined precisely.

Members of the study population were requested to sign a Social Security Authorization form, sent along with their questionnaire, which authorized the Social Security Administration to release the record of the amount of individual earnings to the authors on a confidential basis.

Social Security earnings have the weakness that not all income is covered. In particular, railroad employees, members of the classified civil service, and certain employees of states, municipalities, and non-profit corporations are excluded. Only two percent of the study population listed an employer who was apparently exempt, and their Social Security records showed zero earnings even though they reported employment. In these cases high quarter earnings were estimated from the worker's own statement of his wage rate, multiplying his hourly rate by 520, his weekly rate by 13, or his monthly rate by 3 in order to determine his quarterly wage rate. About the same number of these multiplied estimates were made for the Experimental Subjects and for their cohorts, so that any bias introduced by use of these estimates should be minimal when the differences between the two groups are considered.

The Social Security data were used to make two kinds of earnings estimates: Earnings and potential earnings. In estimating earnings, the actual quarterly amounts recorded in the individual account for 1968 were used. However, the amount of income determined in this way fluctuated widely due to unemployment and, more particularly, nonparticipation in the labor force. This fluctuation would tend to distort measurements of the income value of vocational training. Therefore, potential earnings were also computed.

Potential earnings were determined for each individual by selecting, from the whole period over which there was a record of earnings, the highest income quarter and multiplying this amount by four to determine the annual potential earnings. Of the two, potential earnings was found to be the more stable measure over time and among individuals. This measure has been used frequently throughout the remainder of the report in comparing relative income differences among various classes, and the reader is cautioned not to interpret it as an indicator of actual income.

Similarly, when computing rates of return, two possible earnings bases for the lifetime estimate were considered. Since Social Security records are kept by calendar quarters, the first estimate was simply the highest quarter of earnings from the Social Security record of each individual. This can reasonably be taken as an index of the worker's earning capacity, and quarters of lower earnings could be written off on the assumption that the worker was probably working below capacity. (This assumption, incidentally, is used in determining unemployment insurance benefits in Tennessee and many other states.) Logical support for this approach can be found in the idea that vocational training increases the individual's earnings potential, and we are interested in measuring his potential rather than his actual earnings.

Another possible earnings base is the entire period that has elapsed since departure from school, a period that spans at least a full year because of the selection process used (students who left AVTS after January 1, 1968, were eliminated from the study at an early stage), and includes as many as 18 calendar quarters in the case of the earliest student. Use of such an earnings base is preferable to the one-quarter base, since it takes into account the periods of unemployment or nonparticipation in the labor force, which have a substantial effect upon lifetime earnings and may differ between the members of a matched pair. However, the longer base period has the disadvantage that it will often include quarters of zero or extremely low earnings that are related to such erratic factors as illness, childbearing, or accidents that have no reasonable economic interpretation.

Rates of return on both bases were computed and the results were found to be quite similar. Since the high quarter base made it possible to use a larger sample of 127 subjects (earnings over time were not available for some subjects), it was decided to use this approach, and all the results reported here were calculated from the high quarter formula which will be described in more detail in the paragraphs that follow.

Social Security covered earnings, as was stated earlier, are preferable to many other forms of earnings estimates, and the authors believe that, in general, earnings estimates from Social Security are more accurate than the workers' own estimates of their earnings which have served as the basis for earnings estimates in many other studies, and which were obtained on Form B, the basic questionnaire.

The Study Population

Before the income analysis, detailed reference should be made to the specific AVTS population of former students upon which this analysis is based. Although this is redundant, confusion may be avoided by repeating here a brief definition of the study population.

This analysis is based upon the study of two samples. The first sample consisted of 127 former AVTS students (Experimental Group) randomly selected from among all former AVTS students who met the following criteria: (a) graduate of a Tennessee high school; (b) born in 1943, or later; (c) received at least 300 hours of AVTS instruction before 1968; (d) had a potential full year of civilian labor force experience in 1968 (excluding military and college); and (e) responded to our questionnaire and could be matched. Included also in this sample were 127 cohorts (Control Group) selected from the high-school graduating classes of the experimental members individually matched with regard to sex, age, I.Q., rank in graduating class, race, and, where the records allowed, program of high-school study and father's occupation.

The second population studied was represented by a sample of 411 randomly selected former AVTS students. This population consisted of all former AVTS students who met the following criteria: (a) had a year of full civilian labor force experience in 1968; (b) received 300 or more hours of AVTS instruction prior to 1968; (c) were not students in other vocational schools or colleges in 1968; and (d) responded to the questionnaires. By definition, this second sample of 411 included the former sample of 127 experimental members, excluding the cohorts.

The two samples were utilized in two different ways. The sample of 127 experimental members and 127 cohorts was used to determine rates of return and benefit-cost ratios where the matches were needed to estimate, as closely as possible, what would have been the labor force experience of the former AVTS students had they not received their training. Many of the restrictions placed on acceptance into this sample were adopted in order to make matching possible. For example, graduation from Tennessee high schools was a necessary condition because we could not travel to other states for matching. Nor could suitable matches for dropouts be found due to the scarcity of dropouts at a specific educational level for a specific school in a specific year, and the lack of records on them.

The sample of 411 is used strictly in comparing income effects of various conditions and types of AVTS training rather than the benefit effects. The analysis, then, is divided into two parts: (a) this chapter contains an analysis of the varying conditions and types of AVTS training as they relate to income based on the sample of 411; and (b) Chapter VI contains an analysis of the rates of return to AVTS training under various conditions using the sample of 127 experimental members and 127 control members.

The Effects of AVTS Training on Income

Before presenting the analysis, it is necessary to comment upon the relationships between income and benefits on the one hand, and types and conditions of AVTS training on the other. Although dollar amounts of income and benefits associated with various AVTS categories will be shown, the degree of association is not discussed in this study, nor is the statistical significance of the relationships discussed. These topics are treated in detail in our previously cited report to the United States Office of Education.

The data are presented in tabular form and in dollar amounts, leaving the more technical problems of statistical tests of significance and multiple regression analysis to that report.

Unfortunately, the earnings of women in the United States are much less stable than those of men, as women enter and leave the labor force more frequently than men and often have less stable employment while in the labor force. Thus, male earnings will frequently be analyzed separately from female earnings so that meaning is not sacrificed by the averaging of two such diverse groups. Table 21 shows the distribution of earned income of males who have received AVTS training, by age of the former student in 1968 and by years of education prior to attending AVTS. There appears to be a positive relationship between both income and age, and income and education, i.e., income appears to be increasing as age and prior education increase.

The potential earnings of former AVTS students by age and prior education are given in Table 22. As one would predict, these average earnings are consistently higher than those shown in Table 21, since the former consist of high quarter earnings for the subjects, removing the income effects of unemployment and nonparticipation.

Table 23 reveals the relationships between the 1968 occupations of the former AVTS students and the type of AVTS training received. The training program for each subject was recorded from AVTS records and from the questionnaire, where the subjects had been asked to list their 1968 occupation (the most recent occupation was used in the case of subjects who had more than one occupation in 1968). The occupations were classified into one of the 116 Census occupational titles and were compared with the description of the AVTS training program curricula received by the subject. The subject was coded "directly related" when the training received was a specific preparation for the occupation in question; "indirectly related" where the transfer of skills learned in AVTS appeared to offer facility in the acquisition of the skills required in their present occupation but the training was not a specific preparation (e.g., training in auto mechanics was designated as indirectly related to air conditioning and refrigeration mechanics); and "unrelated" where there was no apparent relation between AVTS training received and present occupation. Some of the occupations required no formal training, e.g., packager, or assembly line inspector, while some respondents did not sufficiently describe their occupation, disallowing classification.

Table 21

MEAN 1968 EARNINGS OF AVTS TRAINED MALES BY AGE AND EDUCATION[a]

AGE	EDUCATION			
	Less Than 8 Years	8 Years	9-11 Years	12 Years
18	0.0	0.0	0.0	$ 3,459.88 (2)
19	0.0	0.0	0.0	3,895.47 (11)
20	$3,030.64 (1)	$3,157.00 (1)	$4,375.52 (2)	4,196.50 (20)
21	3,212.74 (1)	869.80 (2)	3,560.80 (2)	4,071.32 (33)
22	0.0	4,919.29 (2)	3,959.88 (6)	5,006.22 (15)
23	3,487.34 (1)	3,528.77 (1)	3,224.01 (2)	5,115.00 (10)
24	0.0	0.0	0.0	5,045.83 (14)
25	0.0	6,517.46 (1)	5,282.01 (4)	5,763.00 (10)
26	0.0	0.0	2,164.49 (1)	4,786.02 (8)
27	0.0	0.0	0.0	5,831.79 (7)
28	3,571.58 (1)	4,055.10 (2)	2,538.17 (2)	5,038.34 (4)
29	0.0	0.0	0.0	7,081.21 (7)
30	0.0	0.0	3,077.01 (1)	6,169.63 (3)
31	0.0	4,495.61 (3)	0.0	5,056.58 (4)
32	4,488.25 (1)	0.0	0.0	7,077.68 (2)
33	0.0	0.0	0.0	262.37 (1)
34	0.0	0.0	5,485.28 (2)	5,580.93 (2)
35	3,595.60 (1)	0.0	0.0	0.0
36	1,157.00 (1)	0.0	0.0 (1)	0.0
37	0.0	0.0	0.0	0.0
38	0.0	5,033.91 (1)	0.0	13,282.33 (1)
39	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	5,772.34 (1)

(Continued)

Table 21 (Continued)

AGE	EDUCATION			
	Less Than 8 Years	8 Years	9-11 Years	12 Years
41	0.0	0.0	0.0	$6,694.54 (2)
42	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0
47	$2,148.77 (1)	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0
49	0.0	0.0	0.0	0.0
50	0.0	0.0	0.0	0.0
51	0.0	$7,800.00 (1)	0.0	0.0
52	0.0	0.0	0.0	0.0
53	0.0	0.0	$5,786.53 (1)	0.0
54	3,990.48 (1)	0.0	0.0	0.0
55	0.0	0.0	0.0	0.0
56	3,345.36 (1)	0.0	0.0	0.0
57	0.0	6,575.49 (1)	0.0	0.0
Mean	$3,202.77 (10)	$4,385.92 (15)	$3,730.42 (31)	$4,861.75 (158)

[a] Number of observations shown in parentheses.

Table 22

MEAN ANNUAL EARNING POTENTIAL OF AVTS TRAINED MALES BY AGE AND EDUCATION[a]

AGE	EDUCATION			
	Less Than 8 Years	8 Years	9-11 Years	12 Years
18	0.0	0.0	0.0	$ 3,798.76 (2)
19	0.0	0.0	0.0	5,214.74 (11)
20	$6,097.12 (1)	$3,456.00 (1)	$4,896.38 (2)	5,443.68 (22)
21	3,544.72 (1)	3,067.97 (3)	4,313.09 (12)	5,756.30 (35)
22	0.0	5,792.54 (2)	5,225.49 (6)	6,115.92 (15)
23	4,055.80 (1)	3,720.00 (1)	5,249.70 (2)	6,929.85 (10)
24	0.0	0.0	0.0	6,433.39 (14)
25	0.0	9,796.60 (1)	7,552.35 (4)	6,877.82 (10)
26	0.0	0.0	3,300.00 (1)	6,450.88 (8)
27	0.0	0.0	0.0	7,334.25 (7)
28	4,081.24 (1)	4,776.68 (2)	3,308.82 (2)	7,974.39 (4)
29	0.0	0.0	0.0	8,267.61 (9)
30	0.0	0.0	5,455.88 (1)	7,131.58 (4)
31	0.0	5,917.77 (3)	1,540.68 (2)	6,226.74 (4)
32	5,706.44 (1)	0.0	0.0	8,596.52 (2)
33	0.0	0.0	0.0	1,006.24 (1)
34	0.0	0.0	7,491.24 (2)	6,039.68 (2)
35	5,859.92 (1)	0.0	0.0	5,160.00 (1)
36	4,164.00 (1)	0.0	3,199.24 (1)	4,398.24 (2)
37	0.0	0.0	0.0	0.0
38	0.0	5,589.92 (1)	0.0	13,219.07 (2)
39	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	6,646.60 (1)
41	0.0	0.0	0.0	7,468.56 (2)

(Continued)

Table 22 (Continued)

AGE	EDUCATION			
	Less Than 8 Years	8 Years	9-11 Years	12 Years
42	0.0	0.0	$6,000.00 (1)	0.0
43	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0
47	$4,429.16 (1)	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0
49	0.0	0.0	0.0	0.0
50	0.0	0.0	0.0	0.0 (1)
51	0.0	$9,263.36 (1)	0.0	0.0
52	0.0	0.0	0.0	0.0
53	0.0	0.0	7,790.96 (1)	0.0
54	5,775.72 (1)	0.0	0.0	0.0
55	0.0	0.0	0.0	0.0
56	6,081.80 (1)	0.0	0.0	0.0
57	0.0	7,680.48 (1)	0.0	0.0
58	0.0	0.0	0.0	0.0
59	0.0	0.0	0.0	0.0
60	0.0	0.0	4,320.00 (1)	0.0
Mean	$4,979.59 (10)	$5,550.12 (16)	$4,956.80 (38)	$6,278.18 (169)

[a] Number of observations shown in parentheses.

Table 23

MEAN 1968 EARNINGS OF FORMER AVTS STUDENTS BY RELATEDNESS OF LAST 1968 OCCUPATION TO TRAINING PROGRAM[a]

Relatedness	Mean 1968 Earnings
Program of Instruction Directly Related to Occupation	$4,066.09 (186)
Programs of Instruction Indirectly Related to Occupation	4,395.38 (32)
Program of Instruction Unrelated to Occupation	4,244.30 (55)
No Formal Training Required for Occupation	3,948.85 (72)
Unknown	1,108.41 (25)
Mean	$3,898.28 (370)

[a] Number of observations shown in parentheses.

Tables 23 and 24 show an apparent negative relationship between relatedness and income, although this relationship and all of those to be discussed subsequently in this chapter and the next are subject to later revision, as our knowledge of the effects of a specific variable upon income and benefits is increased through the more precise scrutiny of analysis of covariance. At the present level of investigation, several interpretations of this negative relationship are possible.. First, one could reason that the AVTS program gears its output to low wage occupations or industries, and there is some evidence that this may be true of training in Office Occupations and Health Occupations. (See Table 25.)

Another interpretation is that behavioral changes in the former AVTS students, as a consequence of a favorable learning experience, counseling, guidance, and identification with the world of work, increased the rationality and motivation of the subjects to such an extent that these benefits outweighed those of a specific skill. That is, behavior in the labor market was more important than skill formation. Again, there is some evidence that this principle may also have been in operation, since average earnings do not appear to increase with increased hours of instruction, particularly among males in non-certification programs. (See Table 25.)

Another interpretation is that the negative relationship between relatedness and income is spurious and explained by other variables. For example, there may be a concentration of females in related occupations, thereby reducing the mean income.

Table 24

MEAN EARNINGS POTENTIAL OF FORMER AVTS STUDENTS BY RELATEDNESS OF LAST 1968 OCCUPATION TO TRAINING PROGRESS[a]

Relatedness	Mean Potential Earnings (per year)
Program of Instruction Directly Related to Occupation	$5,286.58 (209)
Program of Instruction Indirectly Related to Occupation	5,801.76 (33)
Program of Instruction Unrelated to Occupation	5,921.38 (59)
No Formal Training Required for Occupation	5,160.66 (75)
Unknown	2,797.72 (35)
Mean	$5,183 56 (411)

[a] Number of observations shown in parentheses.

Table 25

MEAN EARNINGS OF FORMER AVTS STUDENTS BY PROGRAM OF TRAINING AND HOURS OF INSTRUCTION[a]

Program	Hours of Instruction					
	300 to 699 Hrs.	700 to 1099 Hrs.	1100 to 1499 Hrs.	1500 to 1899 Hrs.	1900 hours and over	Total
Drafting	$4,801.83 (14)	$4,552.07 (7)	$6,462.25 (8)	$4,244.98 (6)	$4,109.86 (7)	$4,881.58 (42)
Welding	4,120.24 (10)	4,710.52 (16)	4,584.32 (7)	2,612.75 (4)	608.22 (1)	4,203.14 (38)
Office Occ.	2,651.81 (47)	3,001.71 (31)	2,184.73 (18)	4,087.73 (4)	1,391.84 (2)	2,707.32 (102)
Mech & Repair	4,979.15 (39)	4,744.30 (25)	4,267.25 (19)	5,573.39 (5)	3,791.99 (21)	4,599.72 (109)
Machine Shop	4,127.13 (8)	4,954.08 (14)	4,742.82 (4)	3,926.59 (3)	4,996.15 (8)	4,678.21 (37)
Cosmetology	55.63 (3)	0.0	0.0	4,209.68 (2)	0.0	1,717.25 (5)
Health Occ.	1,772.60 (2)	0.0	2,370.26 (4)	0.0	3,401.37 (31)	3,201.85 (37)
Total	$3,772.17 (123)	$4,174.72 (93)	$3,877.38 (60)	$4,180.73 (24)	$3,674.33 (70)	$3,898.28 (370)

[a] Number of observations are shown in parentheses.

Tables 25 and 26 show mean income and potential income, respectively, by hours of instruction, in seven classes of training programs. In order of highest mean income by program (Total column), the effect of sex segregation is obvious. Former AVTS students in the Drafting program (although their 1968 occupation was not necessarily drafting) led in mean income, followed by Machine Shop (including Sheet Metal), and Mechanics and Repairmen (including Electronics, Electricity, Auto Mechanics, Refrigeration and Air Conditioning, Small Gas Engines, Radio and TV, Appliance Repairmen, and Office Machine Repairmen). Cosmetology had the lowest mean income, followed by Office Occupations, and Health Occupations (including Licensed Practical Nurse, Supply Room Technician, Operating Room Technician, and Certified Lab Assistant).

Table 26 does not show the same order. Again Drafting led, but this program was followed by Welding, Machine Shop, and then Mechanics and Repairmen. The order of programs of lowest potential income is identical to that in Table 25.

Tables 25 and 26 also reveal the relationship of income and potential income to hours of instruction. Following the Total row in Table 25, two income peaks can be seen at 1500 to 1899 hours of instruction, and 700 to 1099 hours. Table 26 shows peaks at 1500 to 1899 hours, and at 300 to 699 hours. Both tables show decreasing income at 1900 hours and over. Although the whys cannot be answered at this time, it is apparent that those who remained the longest in AVTS, and who received the greatest number of hours of instruction (in non-certification programs), were not rewarded with the highest income.

The above situation could be an inherent concomitant of the principle of individual progress utilized by the AVTS, whereby the individual student proceeds through a program at a rate determined by his acquisition of skill. Thus, the brighter, more highly motivated students could have reached entry level skill earlier and been offered jobs earlier than their slower counterparts who remained in training for longer periods of time, and who never reached the income level of the early leavers.

Table 26

MEAN EARNING ESTIMATES OF FORMER AVTS STUDENTS BY PROGRAM OF TRAINING AND HOURS OF INSTRUCTION[a]

Program	Hours of Instruction					
	300 to 699 Hrs.	700 to 1099 Hrs.	1100 to 1499 Hrs.	1500 to 1899 Hrs.	1900 hours and over	Total
Drafting	$6,271.81 (14)	$5,493.92 (7)	$8,946.27 (8)	$5,773.64 (6)	$5,088.45 (7)	$6,308.40 (42)
Welding	6,094.18 (10)	6,522.94 (16)	6,016.32 (7)	5,847.53 (4)	2,432.88 (1)	6,132.93 (38)
Office Occ.	3,780.72 (47)	3,864.89 (31)	3,575.12 (18)	4,793.75 (4)	2,337.04 (2)	3,779.46 (102)
Mech & Repair	6,690.00 (39)	5,698.40 (25)	5,475.79 (19)	6,089.00 (5)	4,467.63 (21)	5,759.50 (109)
Machine Shop	6,775.91 (8)	5,495.12 (14)	5,784.09 (4)	6,289.84 (3)	6,377.46 (8)	6,029.59 (37)
Cosmetology	1,855.09 (3)	0.0	1,077.56 (1)	6,268.80 (2)	0.0	3,196.74 (5)
Health Occ.	3,240.44 (2)	0.0	3,368.08 (4)	0.0	4,710.69 (31)	4,550.86 (37)
Total	$5,318.97 (123)	$5,198.03 (93)	$5,239.10 (60)	$5,803.52 (24)	$4,746.84 (70)	$5,183.98 (370)

[a] Number of observations are shown in parentheses.

Tables 27 and 28 indicate the importance of additional formal training beyond AVTS. The apparent income increments attributable to AVTS may be less direct than is commonly believed. The data in Tables 27 and 28 support the conclusion that indirect income effects may outweigh direct effects. Earlier in the study, indirect effects of AVTS were defined as the increased probability of both pursuing and being accepted into formal training programs such as OJT, Bureau of Apprenticeship and Training Programs, private vocational schools, and correspondence schools. The return to indirect effects includes not only returns to AVTS training but also to the extra training obtained later, but as a result of AVTS training.

Tables 27 and 28 both show that income and potential income increase with amount and relatedness of additional training. These data were obtained from the questionnaires in which the respondents were asked if they had received additional training, and if so, what type and of what duration. Again, their description of additional training was compared with their last 1968 occupation to determine relatedness and amount of additional training (assuming 100 hours of full-time training per month).

Tables 29 and 30 show mean income and mean potential income, respectively, by sex. The well-known earning differences between males and females are strongly documented. In 1968 the female former AVTS students earned only 60 percent of the earnings of their male counterparts. Even when the effects of unemployment and nonparticipation are removed by comparing potential income differences between the sexes in Table 30, the females had an earning potential of only 66 percent of that of males.

Table 27

MEAN EARNINGS OF FORMER AVTS STUDENTS BY RELATEDNESS AND AMOUNT OF ADDITIONAL TRAINING[a]

Relatedness and Amount of Additional Training (Extra AVTS)	Mean Earnings
No additional training	$3,750.14 (271)
Less than 1000 hours of training unrelated to 1968 occupation(s)	4,237.80 (28)
Less than 1000 hours of training related to 1968 occupation(s)	5,082.46 (29)
One year of college or more	3,090.27 (20)
Over 1000 hours of training unrelated to 1968 occupation(s)	3,007.17 (4)
Over 1000 hours of training related to 1968 occupation(s)	4,923.50 (15)
Over one year of college and over 1000 hours of training related to 1968 occupations	4,123.30 (3)
Mean	$3,898.36 (370)

[a] Number of observations shown in parentheses.

Table 28

MEAN EARNINGS OF FORMER AVTS STUDENTS BY RELATEDNESS AND AMOUNT OF ADDITIONAL TRAINING[a]

Relatedness and Amount of Additional Training (Beyond AVTS)	Mean Earnings
No additional training	$4,982.05 (296)
Less than 1000 hours of training unrelated to 1968 occupation(s)	5,803.94 (35)
Less than 1000 hours of training related to 1968 occupation(s)	6,019.83 (33)
One year of College or more	4,592.53 (22)
Over 1000 hours of training unrelated to 1968 occupation(s)	6,117.89 (5)
Over 1000 hours of training related to 1968 occupation(s)	6,390.84 (16)
Over one year of College and over 1000 hours of training related to 1968 occupations	5,074.86 (4)
Total Mean	$5,184.08 (411)

[a] Number of observations shown in parentheses.

Table 29

MEAN EARNINGS OF
FORMER AVTS STUDENTS BY SEX[a]

Sex	Mean Earnings
Male	$4,594.46 (230)
Female	2,754.88 (140)
Mean	$3,898.40 (370)

[a] Number of observations shown in parentheses.

Table 30

EARNINGS POTENTIAL OF FORMER AVTS STUDENTS BY SEX[a]

Sex	Mean Earnings
Male	$5,971.00 (252)
Female	3,936.89 (159)
Mean	$5,184.08 (411)

[a] Number of observations shown in parentheses.

Tables 31 and 32 show the relative income and income potential of school dropouts as a percentage of high-school graduates, both having received AVTS training. Each column cell of income was divided by the fourth column cell (12 years) of income for each corresponding age. Thus, reading from Table 32 in the twenty-two-year-age category reveals that there were no subjects in the sample with less than eight years of prior education; the two subjects with eight years of education averaged 94.7 percent of the average of the fifteen high-school graduates in that age category; and the six high school dropouts (9-11 years of prior education) averaged 85.4 percent of the same high-school graduates. The Mean row at the bottom of both Tables 31 and 32 again documents the well-known relationship between education and income. The reader is cautioned, however, not to interpret this to mean that high-school graduates necessarily received a relatively greater increase in income over dropouts as a result of AVTS training, for this question will occupy the remainder of the analysis of earned income.

An attempt must be made to answer the question of who receives the greatest relative benefit from vocational training--the school dropout, or the high-school graduate. The authors have attempted to do so and will state their tentative conclusion before presenting and discussing the various tests and results which led to it. This study supports the conclusion that there is little, if any, difference between the expected percentage increase in income of dropouts receiving AVTS training and high-school graduates receiving AVTS training, although the high-school graduates can expect a greater increase in absolute terms.

There was no practical way to develop a precisely matched control group of cohorts for the AVTS sample of high-school dropouts, because school records for dropouts were generally inadequate, and the probability of finding similar dropouts was small. It was therefore necessary to depend on published data. Although not directly comparable, these data were used indirectly to compare and test the relative gains of vocationally trained dropouts and vocationally trained high-school graduates.

Table 31

MEAN EARNINGS OF MALE AVTS TRAINED PUBLIC SCHOOL DROPOUTS AS A PERCENT OF AVTS TRAINED HIGH SCHOOL GRADUATES[a]

AGE	EDUCATION			
	Less Than 8 Years	8 Years	9-11 Years	12 Years
20	72.22 (1)	75.23 (1)	104.27 (2)	100.00 (20)
21	78.91 (1)	21.36 (2)	87.45 (8)	100.00 (33)
22	--[b]	98.26 (2)	79.10 (6)	100.00 (15)
23	68.18 (1)	68.99 (1)	63.03 (2)	100.00 (10)
24	--	--	--	100.00 (14)
25	--	113.09 (1)	91.65 (4)	100.00 (10)
26	--	--	45.23 (1)	100.00 (8)
27	--	--	--	100.00 (7)
28	70.89 (1)	80.48 (2)	50.38 (2)	100.00 (4)
29	--	--	--	100.00 (7)
30	--	--	49.87 (1)	100.00 (3)
31	--	88.91 (3)	0.0 (1)	100.00 (4)
32	63.41 (1)	--	--	100.00 (2)
33	--	--	--	100.00 (1)
34	--	--	98.29 (2)	100.00 (2)
35	--	--	--	--
36	--	--	--	--
37	--	--	--	--
38	--	37.90 (1)	--	100.00 (1)
Mean	70.72 (5)	74.01 (13)	78.20 (29)	--

[a] Number of observations shown in parentheses.

[b] No observations.

Table 32

MEAN EARNINGS POTENTIAL OF MALE AVTS TRAINED PUBLIC SCHOOL DROPOUTS AS A PERCENT OF AVTS TRAINED HIGH SCHOOL GRADUATES[a]

AGE	EDUCATION			
	Less Than 8 Years	8 Years	9-11 Years	12 Years
20	112.00 (1)	63.49 (1)	89.95 (2)	100.00 (22)
21	61.58 (1)	70.67 (3)	74.93 (12)	100.00 (35)
22	--[b]	94.71 (2)	85.44 (6)	100.00 (15)
23	58.53 (1)	53.68 (1)	75.75 (2)	100.00 (10)
24	--	--	--	100.00 (14)
25	--	116.27 (1)	109.81 (4)	100.00 (10)
26	--	--	51.16 (1)	100.00 (8)
27	--	--	--	100.00 (7)
28	51.18 (1)	59.90 (2)	41.49 (2)	100.00 (4)
29	--	--	--	100.00 (9)
30	--	--	76.50 (1)	100.00 (11)
31	--	95.04 (3)	24.74 (2)	100.00 (4)
32	66.38 (1)	--	--	100.00 (2)
33	--	--	--	100.00 (1)
34	--	--	124.03 (2)	100.00 (2)
35	113.56 (1)	--	--	100.00 (1)
36	94.67 (1)	--	72.74 (1)	100.00 (2)
37	--	--	--	--
38	--	42.29 (1)	--	100.00 (2)
Mean	79.7 (7)	77.29 (14)	78.95 (35)	--

[a] Number of observations shown in parentheses.

[b] No observations.

The most convenient data available, in terms of its compilation, was a Current Population Report by the Bureau of the Census. The data shown in Tables 33 and 34 were computed from this publication. Table 33 shows mean total annual income reported by individuals in a household sample of the national labor force. Although the data reported in the Current Population Report were for selected years during the period 1956 to 1966, a good fit was obtained by using the straight line projections to 1968 that are shown in Table 33. These income data in Table 33 are compiled by age and education for a national sample of males who had income during the base periods. These income data are not comparable to the study population income data obtained from the Social Security Administration. The former consist of various kinds or sources of income, including income earned from jobs, profits, dividends, rent, and interest, while the latter consist of earned income only.

The reader will recall that it is not necessarily the precise earning amounts that need to be compared to solve the problem, but ratios within the data: the income of dropouts as a ratio of the income of high-school graduates. Table 34 shows the national sample percentages of the income of dropouts as a percentage of high-school graduates by age. The data from the original Current Population Report have now been converted into an extremely useful form, because they are now comparable to the AVTS study population data when converted in the same manner.

The solution to the original problem that led us into this maze of ciphers can now be restated in terms of a test of the data at hand. If it is established from Table 34 that, on the average, twenty-one-year-olds with eight years of education had an income of 86.4 percent of twenty-one year-old high-school graduates, one would expect to find that same percentage if the same comparison were made within the AVTS study population if AVTS training does not redistribute income among persons of differing educational backgrounds. If within the AVTS study population, the respective percentages for various levels of educational attainment are less than the national sample counterparts, AVTS has redistributed earnings upward (giving relatively more to high-school graduates); if greater, AVTS has redistributed earnings downward (giving relatively more to dropouts); if the same, AVTS has not redistributed earnings (increased the earnings of both groups equally).

Table 33

ESTIMATED INCOME FOR MALES IN 1968 BY AGE AND EDUCATION[a]

AGE	EDUCATION			
	Less Than 8 Years	8 Years	9-11 Years	12 Years
18	$1,592.17	$2,101.60	$ 573.32	$1,775.00
19	1,898.44	2,421.82	1,215.67	2,379.00
20	2,188.17	2,728.57	1,822.00	2,953.00
21	2,460.48	3,019.68	2,394.07	3,495.00
22	2,713.42	3,302.59	2,933.86	4,008.00
23	2,954.42	3,565.06	3,439.34	4,490.00
24	3,177.06	3,819.39	3,913.27	4,941.00
25	3,383.42	4,053.67	4,348.58	5,262.00
26	3,572.61	4,280.23	4,751.98	5,753.00
27	3,753.38	4,493.05	5,116.58	6,113.00
28	3,897.41	4,683.33	5,449.93	6,442.00
29	4,037.86	4,867.00	5,750.07	6,741.00
30	4,155.15	5,038.03	6,012.00	7,007.00
31	4,249.47	5,188.98	6,222.45	7,227.00
32	4,323.35	5,322.75	6,381.38	7,403.00
33	4,374.94	5,446.04	6,502.06	7,543.00
34	4,409.28	5,557.53	6,583.30	7,655.00
35	4,436.73	5,652.39	6,651.23	7,743.00
36	4,446.73	5,736.21	6,689.64	7,815.00
37	4,458.95	5,806.08	6,727.81	7,878.00
38	4,461.71	5,874.86	6,771.96	7,939.00
39	4,474.23	5,930.96	6,811.40	8,004.00
40	4,490.25	5,984.31	6,864.60	8,076.00
41	4,503.63	6,018.41	6,938.68	8,144.00
42	4,503.45	6,037.41	6,988.95	8,203.00
43	4,507.23	6,050.91	7,041.51	8,255.00
44	4,505.81	6,057.54	7,086.49	8,298.00
45	4,499.82	6,049.75	7,124.71	8,333.00

(Continued)

Table 33 (Continued)

AGE	EDUCATION			
	Less Than 8 Years	8 Years	9-11 Years	12 Years
46	$4,488.78	$6,035.20	$7,146.94	$8,359.00
47	4,464.94	6,023.06	7,170.71	8,377.00
48	4,453.50	5,996.70	7,179.27	8,387.00
49	4,428.33	5,979.93	7,179.27	8,387.00
50	4,398.45	5,956.75	7,163.19	8,378.00
51	4,372.80	5,927.95	7,140.29	8,361.00
52	4,333.68	5,892.14	7,108.90	8,334.00
53	4,291.10	5,859.80	7,063.30	8,300.00
54	4,251.84	5,820.48	7,017.60	8,256.00
55	4,200.45	5,775.61	6,956.99	8,204.00
56	4,153.44	5,725.23	6,889.82	8,144.00
57	4,101.59	5,676.02	6,814.45	8,074.00
58	4,038.48	5,613.89	6,725.47	7,997.00
59	3,970.82	5,544.91	6,628.58	7,910.00
60	3,907.50	5,478.31	6,525.52	7,815.00
61	3,840.08	5,405.41	6,407.84	7,711.00
62	3,761.50	5,326.89	6,284.37	7,599.00
63	3,686.16	5,248.85	6,153.57	7,477.00
64+	3,600.52	5,165.64	6,010.66	7,348.00

[a] The estimated income was obtained from a national sample of males reporting income in 1966: Current Population Reports: Consumer Income. "Annual Mean Income, Lifetime Income, and Educational Attainment of Men in the United States, for Selected Years, 1956 to 1966," Tables 7 and 8. The above table was computed from 1968 projections of the reported income from 1956 to 1966.

Table 34

ESTIMATED INCOME FOR MALES IN 1968 BY AGE AND EDUCATION AS A PERCENT OF INCOME OF HIGH SCHOOL GRADUATES[a]

AGE	EDUCATION			
	Less Than 8 Years	8 Years	9-11 Years	12 Years
18	$89.70	$118.40	$32.30	$1.00
19	79.80	101.80	51.10	1.00
20	74.10	92.40	61.70	1.00
21	70.40	86.40	68.50	1.00
22	67.70	82.40	73.20	1.00
23	65.80	79.40	76.60	1.00
24	64.30	77.30	79.20	1.00
25	63.10	75.60	81.10	1.00
26	62.10	74.40	82.60	1.00
27	61.40	73.50	83.70	1.00
28	60.50	72.70	84.60	1.00
29	59.90	72.20	85.30	1.00
30	59.30	71.90	85.80	1.00
31	58.80	71.80	86.10	1.00
32	58.40	71.90	86.20	1.00
33	58.00	72.20	86.20	1.00
34	57.60	72.60	86.00	1.00
35	57.30	73.00	85.90	1.00
36	56.90	73.40	85.60	1.00
37	56.60	73.70	85.40	1.00
38	56.20	74.00	85.30	1.00
39	55.90	74.10	85.10	1.00
40	55.60	74.10	85.00	1.00
41	55.30	73.90	85.20	1.00
42	54.90	73.60	85.20	1.00
43	54.60	73.30	85.30	1.00

(Continued)

Table 34 (Continued)

AGE	EDUCATION			
	Less Than 8 Years	8 Years	9-11 Years	12 Years
44	$54.30	$73.00	$85.40	$1.00
45	54.00	72.60	85.50	1.00
46	53.70	72.20	85.50	1.00
47	53.30	71.90	85.60	1.00
48	53.10	71.50	85.60	1.00
49	52.80	71.30	85.60	1.00
50	52.50	71.10	85.50	1.00
51	52.30	70.90	85.40	1.00
52	52.00	70.70	85.30	1.00
53	51.70	70.60	85.10	1.00
54	51.50	70.50	85.00	1.00
55	51.20	70.40	84.80	1.00
56	51.00	70.30	84.60	1.00
57	50.80	70.30	84.40	1.00
58	50.50	70.20	84.10	1.00
59	50.20	70.10	83.80	1.00
60	50.00	70.10	83.50	1.00
61	49.80	70.10	83.10	1.00
62	49.50	70.10	82.70	1.00
63	49.30	70.20	82.30	1.00
64+	49.00	70.30	81.80	1.00

[a] See footnote on Table 35

Tables 35 and 36 compare the percentages within the national sample and within the AVTS study population. Where the percentages are negative, the AVTS study population earned a smaller percentage of high-school graduate income than the national sample.

Table 36 (it is the more useful of the two since it contains more observations of potential earnings), in the last row showing the mean gain or loss for the three educational attainment groups, reveals that the AVTS group with less than eight years of prior education earned 16.36 percent more of the AVTS high-school graduates' earnings than did the same group in the national sample. The AVTS elementary group earned a slightly smaller percentage (-4.63), while the AVTS high-school dropouts earned a slightly greater percentage (3.82). The overall mean shows a small redistribution of earnings downward (3.42), but it is probably not a significant difference.

A different, but not independent, method of examining the same problem with the same two sets of data is presented in Tables 37 and 38. Here, the array in Table 38 was divided by the array in Table 22, cell by cell. Thus, in Table 38 are found percentages (AVTS potential earnings divided by national sample income) for each age and educational group for which there were observations in the AVTS study population.

Whether or not the percentages are in excess of 100 is meaningless, for the data are not comparable. But when the percentages in the last column (12 years) are compared with those in the first three columns, it can be determined which educational group exceeded the national sample the most. Again, looking at the means in the last row, one can see that the high-school graduates had a larger gain than the elementary dropouts and the elementary graduates, but less than the high-school dropouts. The mean for less than twelve years of education was 143.08 compared with 141.20 for high-school graduates, again favoring the dropouts by the small difference of 1.88. As before, this difference is probably not significant due to the large variance and small sample.

Table 35

EARNING POTENTIAL AS A PERCENT OF HIGH SCHOOL GRADUATE POTENTIAL EARNING BY AGE AND EDUCATION FOR FORMER AVTS MALES MINUS ESTIMATED INCOME OF MALES IN 1968 BY AGE AND EDUCATION AS A PERCENT OF INCOME OF HIGH SCHOOL GRADUATES[a]

AGE	EDUCATION		
	Less Than 8 Years	8 Years	9-11 Years
20	- 1.88 (1)	-17.17 (1)	42.57 (2)
21	8.51 (1)	-65.04 (2)	18.95 (8)
22	--[b]	15.86 (2)	5.90 (6)
23	2.38 (1)	-10.41 (1)	-13.57 (2)
24	--	--	--
25	--	37.49 (1)	10.55 (4)
26	--	--	-37.37 (1)
27	--	--	--
28	10.39 (1)	7.78 (2)	-34.22 (2)
29	--	--	--
30	--	--	-35.93 (1)
31	--	17.11 (3)	--
32	5.01 (1)	--	--
33	--	--	--
34	--	--	12.29 (2)
35	--	--	--
36	--	--	--
37	--	--	--
38	--	-36.10 (1)	--
Mean	4.88 (5)	- 4.44 (13)	5.67 (30)
Overall Mean	2.85 (48)	--	--

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[a] Number of observations shown in parentheses.

[b] No observations.

Table 36

EARNING POTENTIAL AS A PERCENT OF HIGH SCHOOL GRADUATE POTENTIAL EARNING BY AGE AND EDUCATION FOR FORMER AVTS MALES MINUS ESTIMATED INCOME OF MALES IN 1968 BY AGE AND EDUCATION AS A PERCENT OF INCOME OF HIGH SCHOOL GRADUATES[a]

AGE	EDUCATION		
	Less Than 8 Years	8 Years	9-11 Years
20	37.90 (1)	-28.91 (1)	28.25 (2)
21	- 8.82 (1)	-15.73 (3)	6.43 (12)
22	--[b]	12.31 (2)	12.24 (6)
23	- 7.27 (1)	-25.72 (1)	- 0.85 (2)
24	--	--	--
25	--	40.67 (1)	28.71 (4)
26	--	--	-31.44 (1)
27	--	--	--
28	- 9.32 (1)	-12.80 (2)	-43.11 (2)
29	--	--	--
30	--	--	- 9.30 (1)
31	--	23.24 (3)	-61.36 (2)
32	7.98 (1)	--	--
33	--	--	--
34	--	--	38.03 (2)
35	56.26 (1)	--	--
36	37.77 (1)	--	-12.86 (1)
37	--	-73.70 (1)	-85.40 (1)
38	--	-31.71 (1)	--
Mean	16.36 (7)	- 4.63 (13)	3.82 (35)
Overall Mean	3.42 (55)	--	--

[a] Number of observations shown in parentheses.

[b] No observations.

Table 37

EARNINGS OF AVTS MALES IN 1968 BY AGE AND EDUCATION AS A PERCENT OF 1968 INCOME ESTIMATES BY AGE AND EDUCATION[a]

AGE	EDUCATION			
	Less Than 8 Years	8 Years	9-11 Years	12 Years
20	138.50 (1)	115.70 (1)	240.15 (2)	142.11 (20)
21	130.57 (1)	38.80 (2)	148.71 (8)	116.49 (33)
22	--[b]	148.95 (2)	134.97 (6)	124.91 (15)
23	118.04 (1)	98.98 (1)	93.74 (2)	113.92 (10)
24	--	--	--	102.12 (14)
25	--	160.78 (1)	121.47 (4)	107.48 (10)
26	--	--	45.55 (1)	83.19 (8)
27	--	--	--	95.40 (7)
28	91.64 (1)	86.59 (2)	46.57 (2)	78.21 (4)
29	--	--	--	105.05 (7)
30	--	--	51.18 (1)	88.05 (3)
31	--	86.64 (3)	-- (1)	69.97 (4)
32	103.81 (1)	--	--	95.61 (2)
33	--	--	--	3.48 (1)
34	--	--	83.32 (2)	72.91 (2)
35	81.04 (1)	--	--	--
36	26.02 (1)	--	-- (1)	--
37	--	--	--	--
38	--	85.69 (1)	--	167.30 (1)
39	--	--	--	--
40	--	--	--	71.48 (1)
41	--	--	--	82.20 (2)
42	--	--	--	--
43	--	--	--	--

(Continued)

Table 37 (Continued)

AGE	EDUCATION			
	Less Than 8 Years	8 Years	9-11 Years	12 Years
44	--	--	--	--
45	--	--	--	--
46	--	--	--	--
47	48.13 (1)	--	--	--
48	--	--	--	--
49	--	--	--	--
50	--	--	--	-- (1)
51	--	131.58 (1)	--	--
52	--	--	--	--
53	--	--	--	--
54	93.85	--	--	--
55	--	--	--	--
56	80.54 (3)	--	--	--
57	--	115.86 (1)	--	--
Mean	89.77 (13)	99.81 (15)	115.86 (31)	109.5 (145)

[a] Number of observations shown in parentheses.

[b] No observations.

Table 38

EARNING POTENTIAL OF AVTS MALES BY AGE AND EDUCATION AS A PERCENT OF 1968 INCOME ESTIMATES BY AGE AND EDUCATION[a]

AGE	EDUCATION			
	Less Than 8 Years	8 Years	9-11 Years	12 Years
20	278.64 (1)	126.66 (1)	268.74 (2)	184.34 (22)
21	144.07 (1)	134.72 (3)	180.16 (12)	164.70 (35)
22	--	175.39 (2)	178.11 (6)	152.59 (15)
23	137.28 (1)	104.35 (1)	152.64 (2)	154.34 (10)
24	--	--	--	130.20 (14)
25	--	197.27 (1)	173.67 (4)	128.27 (10)
26	--	--	69.44 (1)	112.13 (8)
27	--	--	--	119.98 (7)
28	104.72 (1)	101.99 (2)	60.71 (2)	123.79 (4)
29	--	--	--	122.65 (9)
30	--	--	90.75 (1)	101.78 (4)
31	--	114.04 (3)	24.76 (2)	86.16 (4)
32	131.99 (1)	--	--	116.12 (2)
33	--	--	--	13.34 (1)
34	--	--	113.79 (2)	78.90 (2)
35	132.08 (1)	--	--	66.64 (1)
36	93.64 (1)	--	47.82 (1)	56.28 (2)
37	--	--	--	--
38	--	95.15 (1)	--	166.51 (2)
39	--	--	--	--
40	--	--	--	82.30 (1)
41	--	--	--	91.71 (2)
42	--	--	85.85 (1)	--
43	--	--	--	--
44	--	--	--	--

(Continued)

Table 38 (Continued)

AGE	EDUCATION			
	Less Than 8 Years	8 Years	9-11 Years	12 Years
45	--[b]	--	--	--
46	--	--	--	--
47	99.20 (1)	--	--	--
48	--	--	--	--
49	--	--	--	--
50	--	--	--	0.0 (1)
51	--	156.27 (1)	--	--
52	--	--	--	--
53	--	--	110.30 (1)	--
54	135.84 (1)	--	--	--
55	--	--	--	--
56	146.43 (1)	--	--	--
57	--	135.31 (1)	--	--
58	--	--	--	--
59	--	--	--	--
60	--	--	66.20 (1)	--
Mean	140.39 (10)	132.26 (16)	148.34 (38)	141.20 (156)

[a] Number of observations shown in parentheses.

[b] No observations.

Mean for less than 12 years education = 143.08 (64)

The two sets of data presented in Tables 35 and 36 and Tables 37 and 38 lend strong support to the conclusion stated earlier that AVTS training apparently improves the income of high-school graduates and dropouts by the same percentage.[43] Stated in more analytical terms, if percentage of high-school graduate income from Table 34 were plotted along the vertical axis and education along the horizontal axis, the following relationship would probably obtain: percentage would rise with education but would have different slopes at different educational levels. The relationship $y = f(x)$ would be monotonic increasing: $0 < \frac{dy}{dx} < 0$.

Figure 1 shows this relationship (curve A) with the mean estimated income for dropouts as a percentage of high-school graduate income plotted along the vertical axis and years of educational attainment along the horizontal axis, both from Table 33. The mean income percentages were weighted by the frequency of observations in each age group in the AVTS sample to render them comparable. When the smooth, continuous line is drawn connecting the means, an increasing function does indeed obtain. The low gradient on the curve between eight years of education and nine to eleven years results from an age bias due to the high proportion of the AVTS sample under twenty-two years of age. High-school dropouts under twenty-two years of age are, relative to the other lower educational groups, recent entrants into the labor force, and their educational advantage has not yet overcome the recency disadvantage. (A curve weighted equally for all age groups would not overtly reveal this depression.)

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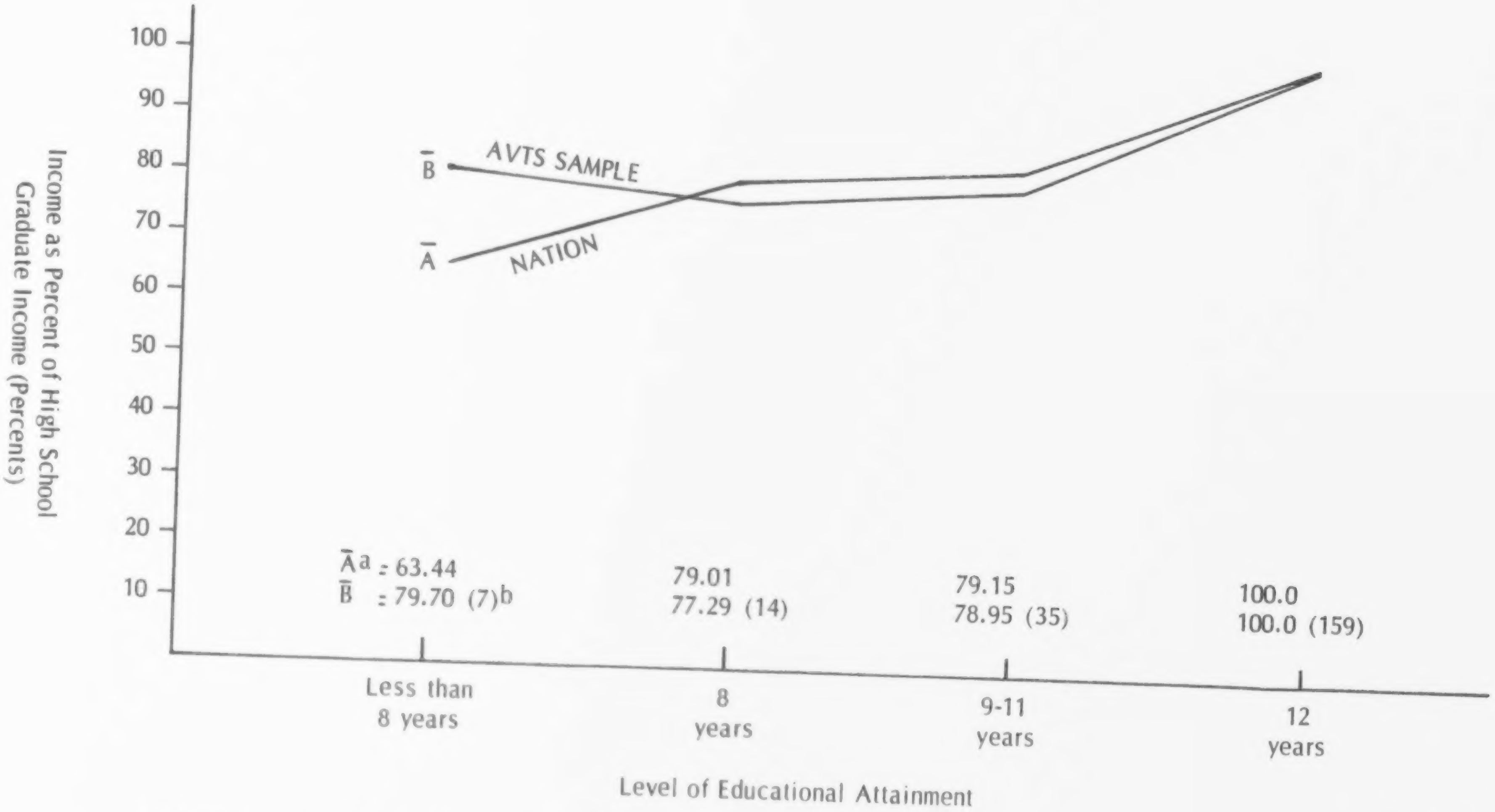
[43] For a more thorough explanation, see R. L. Bowlby and W. R. Schriver, An Analysis of Differential Benefits from Vocational Training, op.cit.

Figure 1

THE RELATIONSHIP OF EDUCATIONAL ATTAINMENT TO INCOME AND EARNINGS POTENTIAL AS PERCENTAGE OF HIGH SCHOOL GRADUATE INCOME AND EARNINGS POTENTIAL IN THE NATION AND IN THE AVTS SAMPLE, RESPECTIVELY



[a] The mean percents for the national sample were computed from Table VIII by weighting the age category by the number of AVTS observations in that category (Table VI A).

[b] Number of observations of all ages shown in parentheses.

When similarly computed mean percentages for the AVTS sample (Table 32) are plotted, and the smooth, continuous, connecting line is drawn, curve B in Figure 1 is obtained. The similarity of the two curves is immediately obvious: the relationship of income to educational attainment appears to be similar within the labor force at large and within the AVTS study population. Although absolute income has increased among the latter group, it is in proportion to their probable earnings potential without vocational training.

The two curves in Figure 1 are not identical, but a test of the differences in the two curves would not show statistical significance, which suggests that the difference is due to sample bias.[44] That is to say, if a universal curve B were plotted from the earnings data for the target population of all former AVTS students, not just those in the study population, it would be superimposed on curve A. The hypothesis that the differences in the means are zero cannot be rejected on the basis of the evidence on hand. (See earlier cited report to U. S. Office of Education.)

Another way of looking at the same relationship is to plot along the y axis estimated income and earnings potential for the national sample and AVTS sample, respectively, instead of the percentages shown in Figure 1, and plot educational attainment along the x axis as usual. This is done in Figure 2 for a slightly different sample of former AVTS students (Table 22) and for national sample means (Table 34) matched and weighted by the age observations in Table 22.[45] Curve A represents the national sample, and curve B, the AVTS study population.

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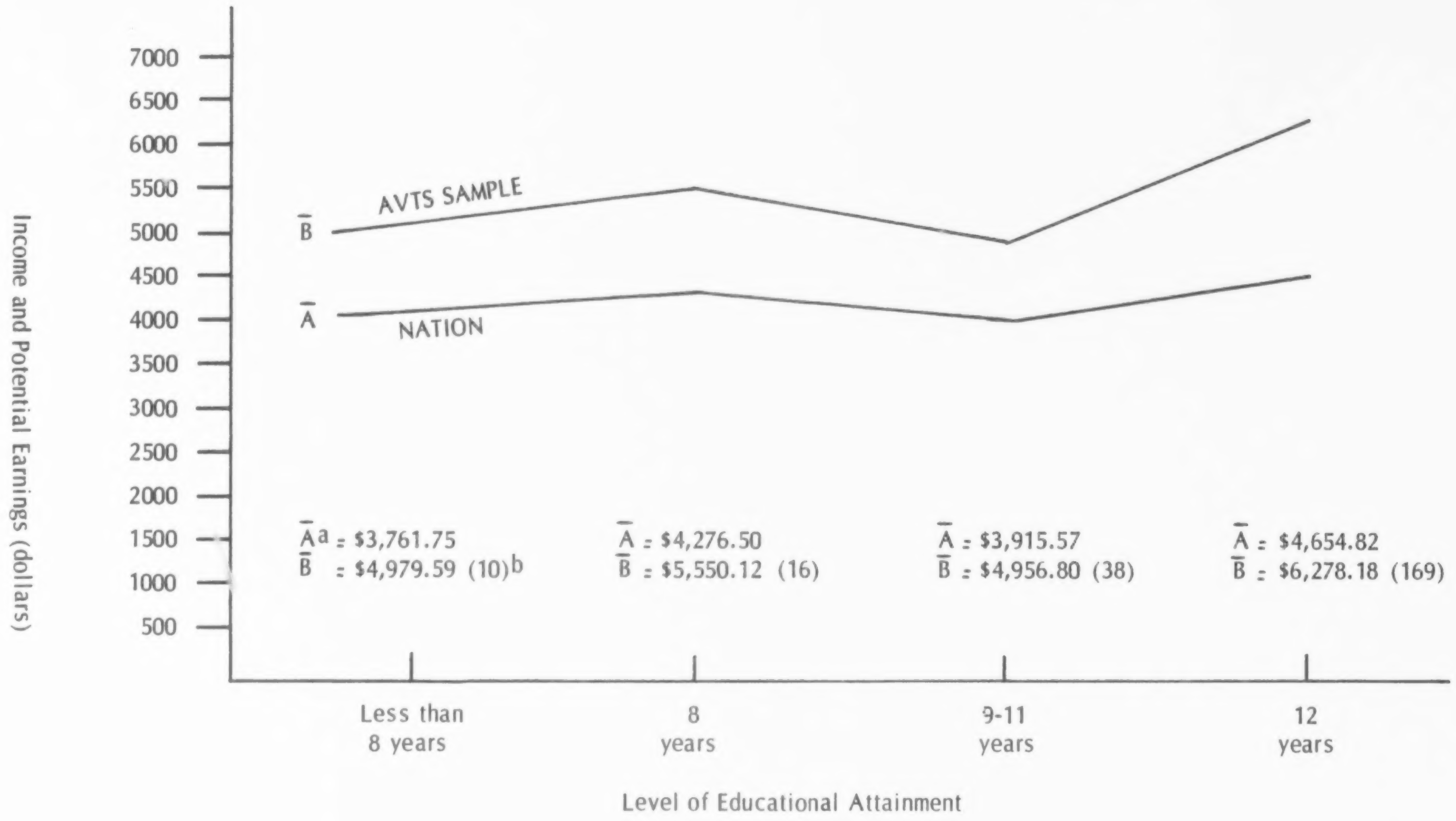
[44] Ibid.

[45] The AVTS sample from which the means in Figure 2 were computed is shown in Table 22, and contains eighteen more observations than Table 32 used in Figure 1. In Figure 1, it was necessary to have a high-school graduate of the same age as each dropout in order to compute the percentages. In Figure 2, all subjects for which there are income data can be used, regardless of the matching in age of dropouts with graduates.

Figure 2

THE RELATIONSHIP OF EDUCATIONAL ATTAINMENT TO INCOME IN THE NATION AND EARNINGS POTENTIAL IN THE AVTS SAMPLE



[a] The mean income for the national sample was computed from Table VII by weighting the age category by the number of AVTS observations in that category (Table I A).

[b] Number of observations of all ages shown in parentheses.

Again, the similarity in the shape of the two curves is obvious. (The age bias is even greater than before, making the slope in both curves negative between eight years and nine to eleven years of education.) Curve B has shifted upward due, in part, to conceptual differences between earnings potential and estimated income and in part to AVTS influence, although no support for this latter point is offered here. The proportionate increases in income and earnings potential remain indelibly clear.

The evidence presented and analyzed thus far indicates that AVTS training apparently does not redistribute earnings with respect to level of educational attainment. The administration of AVTS training to a student population of diverse educational backgrounds does not increase, or decrease, the earnings disparity that exists in the labor force among workers of differing levels of educational attainment. On a more positive note, it is equally true that the earnings of the educationally disadvantaged are just as responsive to vocational training as are the earnings of high-school graduates.

Chapter VI

INTERNAL RATES OF RETURN TO AVTS TRAINING

Vocational training can be identified as an investment in human capital, if it can be shown that the students are more productive than they would have been in the absence of training. It is reasonable to infer higher productivity from higher earnings. Since the increased earnings and the costs have a common denominator in dollars, the two can be compared. This comparison is fundamental to an economic evaluation of vocational education.

Economic logic leads to a simple trichotomy. If vocational education leaves earnings unchanged (or lowers them), one should conclude that it is consumption rather than investment. If training raises earnings, but the increase in earnings is less than the costs of training, one should conclude that vocational training is an investment, albeit a poor one. If the increased earnings are greater than the increased costs, one can conclude that vocational training is a good investment, and the greater the positive difference, the more desirable it becomes in comparison with other possible investments.

A comparison of different investments involves mathematics that becomes a little complicated, and various economic assumptions can yield different rates of return even though a single compound interest formula is used in all the calculations.

If all the costs were incurred in a single time period and all the benefits came in a single later period, it would be easy to evaluate different investment projects by simple interest rates. A project with costs of $50 and benefits of $55 is clearly better than one with costs of $100 and benefits of $106, since it yields a rate of return of 5/50, or 10 percent as compared to a 6 percent return on the latter investment. Using the same logic, an investment costing $50 and yielding a payoff of $55 in one year is better than a $50 project paying back $58 in two years, for the first investment has a yearly return of 10 percent, and the second has a return of 8 percent per year.

Computation of rates of return becomes more difficult when costs and benefits take place in more than one time period, and the rate of return is calculated by the compound interest formula. Table 39 shows some of these complexities by illustrating nine hypothetical investments, with costs and returns spread over three time periods. Each of these nine investments yields a return of 6 percent per year, compounded annually, a fact that can easily be verified by arithmetic calculations. It should be noted that although costs equal $100.00 in each of the nine cases, the total of returns varies from a low of $106.00 in cases 1 and 9 to a high of $112.36 in case 5. This is because of the economic assumption that a dollar today is worth more than a dollar tomorrow. Investment number 5 requires the largest return to reach 6 percent, because it combines the earliest possible costs with the latest possible payback, so that waiting time is maximized and larger payments are required to compensate the investor for this longer waiting.

Table 39

ILLUSTRATIONS OF A SIX PERCENT INTERNAL RATE OF RETURN

Investment Number	Costs (–) or Returns (+) in Each Year		
	Year 1	Year 2	Year 3
1	–100.00	+106.00	0
2	–100.00	+ 72.02	+ 36.01
3	–100.00	+ 54.54	+ 54.54
4	–100.00	+ 36.72	+ 73.44
5	–100.00	0	+112.36
6	– 66.67	– 33.33	+110.24
7	– 50.00	– 50.00	+109.18
8	– 33.33	– 66.67	+108.12
9	0	–100.00	+106.00

Table 39 could be extended to as many time periods as desired, and the costs and benefits could be distributed to come as early or late as desired, by the application of the following formula:

EQUATION 1

$$\frac{COST_1}{(1.06)^0} + \frac{COST_2}{(1.06)^1} + \frac{COST_3}{(1.06)^2} + \frac{COST_4}{(1.06)^3} \ldots + \frac{COST_n}{(1.06)^{n-1}} =$$

$$\frac{BEN_1}{(1.06)^0} + \frac{BEN_2}{(1.06)^1} + \frac{BEN_3}{(1.06)^2} + \frac{BEN_4}{(1.06)^3} \ldots + \frac{BEN_n}{(1.06)^{n-1}}$$

where the cost and benefit subscripts identify the years. Investment number 5 in Table 39 may be used to illustrate the formula, for $(1.06)^0 = 1$, so that the first cost term equals 100, and $(1.06)^2 = 1.06 \times 1.06 = 1.1236$, so that the third cost term is equal to 112.36 divided by 1.1236 or 100, and the equality is maintained. The formula can be generalized and used to compute rates of return other than 6 percent by substituting $1 + r$ for 1.06.

With the aid of this formula, then, the costs and benefits of an investment project can be distributed in any way that one chooses, as long as the rate of return associated with it is known. More importantly, the converse of this proposition is true; the internal rate of return for any investment project whatsoever can be determined as long as we know the amount of each cost, the amount of each benefit, and their spacing over time. Imagine, for example, an investment costing $100 in 1970 and yielding a return of $300 in 2000. The rate of return can be calculated by numbering the years so that 1970 = 1, and 2000 = 31, and applying the formula. This gives the equation

EQUATION 2

$$100 = \frac{300}{(1 + r)^{30}}$$

which can be solved for r since it involves a single unknown. (In this example, r is between 3 and 4 percent.) If the same investment yields a return of $150 in 1985, and $150 in 2000, the rate of return can be computed by solving for r.

EQUATION 3

$$100 = \frac{150}{(1 + r)^{15}} \quad \frac{150}{(1 + r)^{30}}$$

which works out to an r of a little less than 5 percent.

The same technique used in these examples can be used to compute the rate of return for investments in education at Tennessee Area Vocational-Technical Schools. Since it is anticipated that the former students will receive benefits until the year 2034, and since the system incurred costs in each year from 1963 to 1966, the calculations would be practically impossible without the assistance of an electronic computer. A computer program was prepared to solve the following equation:

EQUATION 4

$$\sum_{i=1}^{285} \frac{C_i}{(1 + r)^i} \qquad \sum_{i=1}^{286} \frac{B_i}{(1 + r)^i}$$

where each of the 285 C's and B's are costs and benefits, respectively, during a calendar quarter, beginning with the third quarter of 1963 and ending with the third quarter of 2034.

Four items are included as costs: (1) public capital costs, (2) private capital costs, (3) public operating costs, and (4) private opportunity costs. Each of these four component cost items involves difficulties of measurement and some unavoidable guesswork.

The estimate of $5,666,316.85 as the capital cost of all the schools between 1963 and 1968 was derived by multiplying Professor Bohm's estimate of the annual cost by 5. (See footnote 4 of Appendix A.) This was divided by the 8,156,597 hours of instruction for all AVTS students (taken from Bohm's Table 1) to arrive at an estimate of $0.69 per hour of instruction received as the capital cost for each student. Since the hours of instruction received by each student were recorded from school records, the capital costs for each student would be estimated in the sample of 127 by multiplying his hours of instruction by $0.69. This produced a range of costs varying from $2,112 for the highest student to $210 for the lowest student, with a mean of $884 for the average student and a total of $112,247 for the 127 students as a group.

The private capital cost was a minor item consisting of the estimated cost of books and uniforms which the students were required to purchase as a part of their AVTS course. These costs ranged from $3.45 for a student in sheet metal work to $203.20 for certain health occupations; the mean was $39.66 per student, and the total was $5,033 for the whole group of 127 students.

The third cost estimate was also taken from Professor Bohm's study: in his Table 3, the total of operating costs at all schools is given as $8,551,923.82 for the five fiscal years 1964-68, or $1.05 per hour of instruction. Applying this figure to each of the students gives a total of $169,411 in operating costs, or a mean of $1,334 per student.

Private opportunity costs are defined as the earnings foregone by AVTS students during their attendance at school. This is the most important cost of attending school from the student's standpoint. The living expenses of students in school were not included as costs, since the subjects would have been forced to bear these costs whether or not they attended AVTS. Commuting costs were omitted on the same grounds, since presumably the students traveled about the same distance to attend school that they would have traveled to work if they had not been in school. The private opportunity cost of each student during the period of his AVTS attendance was measured by assuming that if he had not gone to AVTS, he would have earned the same wages as his high-school classmate who did not attend AVTS. For 15 of the 127 subjects, the opportunity costs were negative, which means that they earned more money while attending AVTS than their high-school classmates of equal ability. For the 127 as a group, the algebraic total of costs came to $173,309.40, or $1,364.60 per student. This is about $30 more than the operating costs. It must be concluded, therefore, that even with free tuition, AVTS schooling costs the typical student somewhat more than the variable costs of operating the schools after they are built.

The estimate overstates the net personal costs for some AVTS students, because they received veterans' benefits as a partial or total offset against their foregone earnings. Since veterans' benefits represent a cost to the taxpayers, however, they should be added to the public costs calculated earlier. In this study, veterans' benefits have been neglected entirely, which means that the rates of return are correct for the society (including both taxpayers and students) but too low for the student and too high for the taxpayers.

The sum of all costs to the students and the taxpayers, as itemized above, is presented in Table 40. This means that if the training results in increased earnings of $3,622.03 per student, the rate of return will be zero, for when r is zero, the left and right members of equation 4 will be equal. Put another way, we could set $3,622.03 as a "break-even" point; positive returns do not begin until the student's lifetime earning capacity is increased by more than this amount.

The calculation of increased lifetime earnings attributable to AVTS training involves yet another process of estimation and unavoidable guesswork. The basic estimate is that the observable difference between the earnings of each pair is attributable to AVTS training, since other factors are held constant by the matching process. Sources of earnings data are (1) the questionnaire which was completed by each student and his match, and (2) a report from the Social Security Administration of the wages credited to each worker's numbered account. From this were computed the high quarter of earnings for each subject.

Given the high quarter base, further assumptions are necessary to project these base earnings over the expected working life of each individual. The first assumption is that workers will increase their earnings during most of their working lives because of rising productivity and a secular trend toward price inflation. The President's Council of Economic Advisors has estimated the long-term increase in productivity per man-hour at 3.2 percent per year during recent years. This figure was rounded up to 4 percent to give some recognition to the belief that price increases are more likely than decreases during the working lifetimes of people born during the 1940's.

The age of each individual was obtained from Form D of Appendix B. We used this age to calculate the calendar quarter in which each individual reached age 50, the quarter in which the females reached age 75, and the quarter in which the males reached age 85. Earnings for each student were computed by taking the highest quarter of earnings as income for the first quarter after departure from AVTS, increasing these earnings at one percent per quarter for each quarter until the quarter in which the student reached age 50, and leveling earnings thereafter until age 75 for women and 85 for men. At each age level, and for each sex, the probabilities of survival and of labor force participation were taken from two works by Stuart Garfinkle published by the U. S. Department of Labor.[46] Earnings for these probabilities were adjusted by multiplying earnings by the two probability coefficients.

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[46] Stuart Garfinkle, Work Life Expectancy and Training Needs of Women, Manpower Report No. 12, U. S. Department of Labor (May 1967), and The Length of Working Life for Males, 1900-1960, Manpower Report No. 8, U. S. Department of Labor (July 1963).

Table 40

COST ESTIMATES FOR THE SAMPLE OF 127 STUDENTS

	Total	Per Student
Public (Taxpayer) Costs		
Capital Costs (Plant and Equipment)	$112,246.56	$ 883.83
Operating Costs	$169,410.60	$1,333.94
Total Public Cost	$281,657.16	$2,217.77
Private (Student) Costs		
Capital Costs (Books and Uniforms, etc.)	$ 5,033.44	$ 39.66
Opportunity Costs (Foregone Earnings)	$173,309.40	$1,364.60
Total Private Cost	$178,342.84	$1,404.26
Grand Total, All Costs	$460,000.00	$3,622.03

A numerical example may make the specifications of the earnings model clearer. A student born in the first quarter of 1948 attends AVTS during all four quarters of 1967 and leaves during the fourth quarter of 1967. He works in covered employment during 1968 and answers the questionnaire during 1969, so that his earnings for each quarter of 1968 are obtained from the Social Security Administration. The highest quarter of the four is selected, and these earnings are imputed to the first quarter of 1968. If high quarter earnings are exactly $1,000, the 1 percent rule will be applied and earnings of $1,000, $1,010, $1,020.10, and $1,030.30 will be estimated for the four quarters of 1968, and $1,040.60, $1,051.01, $1,061.52, and $1,072.14 for the four quarters of 1969. By the first quarter of 1998, when the subject reaches age 50, his earnings are estimated at $3,279.53. They remain at that level until the first quarter of 2033.

For each quarter between 1968 and 2033, the earnings are adjusted to account for the probability that the individual might be dead during the quarter, or that he will be living, but not in the labor force. At age 20 the probability that he is living is 1.0 (a certainty, since he answered the questionnaire), and the probability that he is in the labor force is .829 (taken from Garfinkle's publication cited earlier). Multiplying $1,000 x 1 x .829, the student's earnings can be estimated at $829 for the quarter. By the time he reaches age 30, his quarterly earnings will have increased to $1,488.87, but the chance that he will be alive has fallen from 100 percent to .982. Since 96.8 percent of all 30-year old males are in the labor force, the earnings of the imaginary student in the first quarter of 1978 would be estimated at $1,488.87 x .982 x .968 = $1,459.13. The same calculations for age 50 give $3,279.53 x .897 x 95 = $2,794 65. At age 84, in the year 2032, the assumptions are that the worker will still be earning $3,279.53 if he is alive and in the labor force. But his probability of life is only .141, and his probability of being in the labor force is only .102 if he is alive. His 2032 earnings are estimated by multiplying by both factors, and a figure of $47.17 is reached. Since the present value of $47.17 in the year 2032 will be less than $2 in 1968 when discounted at 6 percent (it will be recalled that only present values are used in calculating the rate of return), this method gives very little weight to possible earnings at such advanced ages.

It is again apparent that these calculations are practical only with the aid of a computer, but become reasonably simple and straightforward as soon as a computer program is written to perform the laborious computations outlined in the last two paragraphs. It is also clear that the answer will be conditioned by the nature of the assumptions outlined here, many of which are quite arbitrary. It might be assumed, for example, that all students will retire at 65, and that not one of them will die before age 65. His earnings might be reduced further to adjust for the possibility of unemployment.

Any of these assumptions would produce a different rate of return, but it should be emphasized that exactly the same assumptions are made to project the lifetime earnings of both the AVTS students and their untrained high-school classmates. It follows that the estimate is unbiased in the sense that any changed assumptions have an equal probability of increasing or reducing the computed rate of return.

As a matter of interest, the lifetime earnings in dollars that result from the computer program described here might be noted. The "richest" student had high quarter earnings of $2,942, or $227 per week. This figure was used to project his lifetime earnings potential at more than $1,220,000. One of the untrained cohorts had even higher earnings in his peak quarter, and his lifetime earnings were estimated at $1,432,000. Most of the subjects were considerably lower, and the median lifetime earnings of the 127 was about $300,000.

The Results

The internal rate of return on all costs for the sample of 127 students was 6.3 percent when all four types of cost in equation 4 were included and it was solved for r. This means that the taxpayers and the students collectively earned this rate of return on their capital investment in the schools as a group, with all forms of training considered together. The model shows the taxpayers and students sharing the costs and the students collecting all the benefits. Of course, taxpayers receive benefits from the higher incomes of AVTS graduates, since the AVTS students may be presumed to have lower rates of incarceration and welfare payments by virtue of their higher incomes, and since businessmen who trade with them will find the AVTS students better customers. (This latter phenomenon is the one economists refer to as the "multiplier effect.")

Since it is impossible to measure the benefits to the taxpayers, they will have to be neglected, which means that the 6.3 percent estimate is too low. Another rate of return can be computed ignoring the taxpayer cost, which makes the rate of return symmetrical in the sense that the benefits and costs of the same people (the 127 former AVTS students) are included. This computation involves the same equation 4, but with only the private costs (books, uniforms, and foregone income) included in the left member. The private rate of return computed this way is 13.4 percent, which measures the benefits the typical AVTS student derives from his school experience in relationship to his personal costs.

The same technique used to compute rates of return for the 127 students can be used to compute rates of return and private rates of return for subgroups within the 127. The rates for 18 such subgroups are shown in Table 41.

These rates of return, it will be recalled, take costs as well as benefits into account. Thus, females may have a higher rate of return than males even if their dollar benefits are lower, if their costs (particularly foregone earnings) are sufficiently lower than male costs to more than offset the difference. The differences among groups, such as the high returns to welders and low returns to students of drafting and health occupations, are also influenced by hours of instruction, since the formula used makes all public costs a function of instructional hours. A long program will consequently tend to have a lower rate of return than a short one, if the short program can produce equal dollar benefits.

Table 41

RATES OF RETURN FOR THE SAMPLE AND VARIOUS SUBSAMPLES

Nature of Group	Number of Students	Total Rate of Return (percent)	Private Rate of Return (percent)
All students	127	6.3	13.4
Males	62	2.3	5.9
Females	65	10.0	26.5
Students who remained in their home counties or an adjacent county	109	3.2	7.1
Students who moved	18	19.5	*
Urban students	35	+	+
Rural students	92	8.6	16.4
Students with low (90 or less) I. Q.	20	29.1	73.6
Students with medium (91-110) I. Q.	65	5.9	12.0
Students with high (111 and over) I. Q.	23	+	+
Jobs closely related to AVTS training	82	8.5	16.1
Unrelated jobs	42	+	+
Drafting	17	+	+
Welding	11	9.0	*
Office occupations	46	11.2	27.7
Mechanics and repairmen	22	10.7	20.0
Machine Shop	11	14.7	27.2
Health occupations	20	0.8	4.3
Students with no training except AVTS and completely untrained high school classmates	59	4.5	9.9

*More than 308 percent (too high to compute).
+Less than zero (too low to compute).

The data in Table 41 indicate that the rate of return is higher for females than for males and higher for rural students than for urban ones. They also give a number of other indications of the particular groups of students whose training has yielded the highest benefits both on the basis of social costs (the second column) and on the basis of the student's personal cost (the third column). These results need to be interpreted with caution, for a number of variables influence each rate of return. The high rate of return for females, for example, could be the spurious result of a high rate of return for training in office occupations, and it is possible that a higher rate of return for males would be obtained if more men were trained for office occupations.[47] Alternately, it is possible that the apparent high return for training in office occupations is not genuine, but only a reflection of the fact that the true rate of return for females is higher than the rate for males. Table 41 by itself cannot tell us which of these theories to accept, for it gives only the results, and not the causes. At the same time it is suggestive of areas for future study and, in the absence of such research, it is reasonable to guess that the general picture presented is an accurate one.

Cost-Benefit Ratios

After the internal rates of return are known, it remains to pass a final judgment and determine whether the rate is high or low. In the case of a business firm, the investment project can be evaluated with reasonable objectivity only if the price of money to that firm is known. A profit-seeking business needs to know not only that an investment yields 8 percent, but whether the cost of funds associated with the investment is 6 percent or 10 percent, for the investment will clearly be profitable in the first case and a losing one in the second place.

The computations here indicate that a potential student who had to borrow money from a loan shark at 50 percent would probably be well advised to forego training, but that if he can borrow the money from a bank at 7 percent he will probably collect benefits sufficient to repay his personal costs and reap a handsome surplus in addition. At any rate, the range of rates is such that as long as the schools remain free of tuition there can be little doubt that most programs will be remunerative in economic terms, at least to rural students with academic abilities that are average, or below average.

If an attempt is made to evaluate the rate of return from the state government's standpoint, the problem is even more difficult. As was noted earlier, the computed rate of return neglects economic benefits to any but AVTS students and, of course, neglects non-economic benefits that are certainly relevent to state government even though they are of no importance to a profit-seeking business firm. Even from a purely financial standpoint, it is difficult to guess the cost to the State of Tennessee of borrowing money between now and 2034, when the benefits of students trained before 1968 finally terminate in the model, and widely different rates would certainly be obtained in different time periods.

It is expected that over the next fifty years the state will be able to borrow money at something like a 4 percent interest rate, and we believe that 4 percent is a reasonable rate of return for the state to expect, particularly since there are unmeasured benefits that are clearly positive in addition to the ones which were measured in this study.

It follows that the schools have been a good investment from the state's standpoint. There is every reason to believe that they will prove even more desirable in the future, particularly since according to Professor Bohm's analysis it can be expected that the cost per hour of instruction will decline as enrollment expands, and is probably already lower than indicated by the cost figures of the past.

In the final analysis, each reader of this report will have to decide for himself the rate of return that is necessary to constitute a "good" investment, just as each investor must decide whether to attempt to increase his capital rapidly by buying "growth stocks" or to seek more conservative investments. For those willing to accept the judgment that 4 percent is an acceptable rate of return for investments of this sort, the computed cost-benefit ratios are given in Table 42.

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[47] Ibid.

Mathematically, these figures can be represented by the ratio

$$\sum_{i=1}^{285} \frac{\dfrac{B_i}{(1.04)^i}}{\dfrac{C_i}{(1.04)^i}}$$

where the symbols have the same meanings as in equation 4. So defined, the ratio will be unity when the internal rate of return is 4 percent, less than one when the rate is less than 4 percent, and greater than one for r greater than 4 percent. These ratios may be interpreted as the number of dollars of benefits received for each dollar expenditure, over and above the 4 percent rate of return that was defined as the reasonable one to expect.

For the 127 students as a group, expenditure of a dollar can be expected, by the 21st century, to return the dollar, repay 4 percent interest on the dollar investment, and leave a surplus of 63 cents. For male students, the dollar spent will return somewhat less than a dollar in benefits to the students (though considerably more than 63 cents); but after a deduction is made for the 4 percent cost of the dollar, by the 21 century, 37 cents of the dollar will be gone, and only 63 cents will remain. The other numbers in Table 42 can be interpreted in the same way, and it will be seen that they follow the same pattern as the rates of return in Table 41, as indeed they must, if the rate of return and the benefit-cost ratio is defined this way.

Table 42

COST-BENEFIT RATIOS (FOUR PERCENT) FOR THE SAMPLE OF STUDENTS AND SELECTED SUBSAMPLES

Nature of Group	Cost-Benefit Ratio
All students	1.63
Males	.63
Females	2.92
Students who remained in their home counties or an adjacent county	.80
Students who moved	6.33
Urban students	*
Rural students	2.39
Students with low (90 or less) I.Q.	13.43
Students with medium (91-110) I.Q.	1.54
Students with high (111 and over) I.Q.	*
Jobs closely related to AVTS training	2.48
Unrelated jobs	.07
Drafting	*
Welding	2.29
Office occupations	3.44
Mechanics and repairmen	3.30
Machine Shop	5.07
Health occupations	.32
Students with no training except AVTS and completely untrained high school classmates	1.12

*Since there were no benefits, the cost-benefit ratio could not be computed.

APPENDIX A

Appendix A

THE PUBLIC COST OF THE TENNESSEE AREA VOCATIONAL-TECHNICAL SCHOOL PROGRAM

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November 12, 1969

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THE PUBLIC COST OF THE TENNESSEE AVTS PROGRAM

by

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A public education program generates both private and public costs. The sum of these two cost streams equals the social cost of diverting real and financial resources from other uses either in the public or private sector. The purpose of this report is to present estimates of the public costs of the Tennessee AVTS Program based on data derived from the program's first five years of operation.

1) Growth in Enrollment.

The Tennessee AVTS program has expanded rapidly since its inception in 1963. As column three of table 1 shows, hours of instruction have increased from 322,319 in program's initial year to 3,635,929 in 1967-68. Growth in hours of instruction to full-time students has been particularly impressive. Tables 2a and 2b indicate that full-time student hours of instruction have increased more than ten-fold from 1963-1964 to 1968-1969. On the other hand, part-time student instruction accounted for 12.3% of all hours taught. Due to the decline in part-time hours of instruction since 1965-1966, the over-all hours of instruction growth rate from 1963 to 1968 was somewhat lower than the full-time rate.

2) Economic Analysis.

It is assumed for the purpose of this analysis that actual dollar outlays by the State of Tennessee on the AVTS Program accurately represent the opportunity costs or benefits foregone to society (in this case the citizens of Tennessee) which arise from the allocation of resources to vocational education as opposed to other uses. This is not an unreasonable assumption to make in this case since most of the public costs of the program are actual purchases of goods and services in the open market where relative prices tend to accurately reflect foregone opportunities.

The output of the AVTS Program is assumed to be hours of instruction. This output is produced with the aid of fixed factors (e.g., plant and equipment) and variable factors (e.g., teachers' services). Since capital investment in plant and equipment continued throughout the study period, it is convenient to assume that there are no fixed costs and that the program is moving along long-run cost curves.

Table 1

HOURS OF INSTRUCTION 1963-68
TENNESSEE AVTS PROGRAM

Year	Full Time	Part Time	Total
1963-64	310,394	11,925	322,319
1964-65	539,536	31,690	571,226
1965-66	1,245,637	174,289	1,419,926
1966-67	2,044,420	162,777	2,207,197
1967-68	3,469,283	166,646	3,635,929
TOTALS	7,609,270	547,327	8,156,597

Source: Division of Vocational Education, Department of Education, State of Tennessee.

Table 2a

GROWTH IN HOURS OF INSTRUCTION
TENNESSEE AVTS PROGRAM
(1965-66 = 100)

Year	Full Time Student	Part Time Student	All Students
1963-64	24.9	6.8	22.7
1964-65	43.3	18.2	40.2
1965-66	100.0	100.0	100.0
1966-67	164.1	93.4	155.4
1967-68	278.5	95.6	256.1

Source: Computed from Table 1.

Table 2b

DISTRIBUTION OF HOURS OF INSTRUCTION BY TYPE OF STUDENT

Year	% Full Time	% Part Time	Total
1963-64	96.3	3.7	100.0
1964-65	94.5	5.5	100.0
1965-66	87.7	12.3	100.0
1966-67	92.6	7.4	100.0
1967-68	95.4	4.6	100.0

Source: Computed from Table 1.

Table 3 presents data on the program's capital or fixed factor costs, operating or variable factor costs, and total costs. Outlays for both capital and operating cost have been considerable during the five year period, totaling $17.9 million and $8.5 million, respectively. In addition, both cost items exhibit substantial year-over-year net increases in expenditures. The total cost of the program from 1963 to 1968 exceeded twenty-six million dollars.

From column three in table 3 long-run average and marginal cost schedules have been calculated. These are presented in table 4 and graphed in figure 1 where rough long-run average (LRAC) and marginal (LRMC) cost curves have been fitted to the data. Both curves are falling from left to right with the marginal cost curve lying below the average cost curve.

Although the costs of the vocational education program have been increasing rapidly, the positions and shapes of the long-run average and marginal cost curves indicate that the program has successfully moved along its long-run average cost curve, thereby lowering the average cost per hour of education. These economies were realized, of course, due to the rapid expansion of output produced by the program (e.g., hours of education) which resulted in more efficient use of the system's essentially indivisible factors.[1] Further internal economies can be realized as long as the marginal cost curve remains below the average cost curve. Since marginal cost is in fact still declining throughout the period of observation, it would appear that the possibilities for further increases in the efficiency of the system (i.e., lower average cost per hour of education) are quite extensive. On these grounds, therefore, the output of the system should continue to be expanded rapidly.

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[1] Indivisibilities are usually due to large fixed factor inputs.

Table 3

CAPITAL AND OPERATING COST 1963-68: TENNESSEE AVTS PROGRAM

Year	Capital Cost	Operating Cost	Total Cost
1963-64	319,045.96	293,294.24	612,340.20
1964-65	3,071,023.71	817,644.39	3,888,668.10
1965-66	3,185,937.91	1,745,120.30	4,931,045.21
1966-67	5,539,650.41	2,372,642.81	7,912,293.22
1967-68	5,843,977.93	3,323,222.08	9,167,200.01
Totals	17,959,635.92	8,551,923.82	26,511,559.74

Source: Computed from data provided by: Division of Vocational Education, Department of Education, State of Tennessee.

Table 4

AVERAGE AND MARGINAL COST PER HOUR OF INSTRUCTION 1963-68
TENNESSEE AVTS PROGRAM

Year	Average Cost	Marginal Cost
1963-64	1.90	1.90
1964-65	6.82	1.32
1965-66	3.47	1.23
1966-67	3.58	3.79
1967-68	2.52	.88

Source: Computed from Table 3.

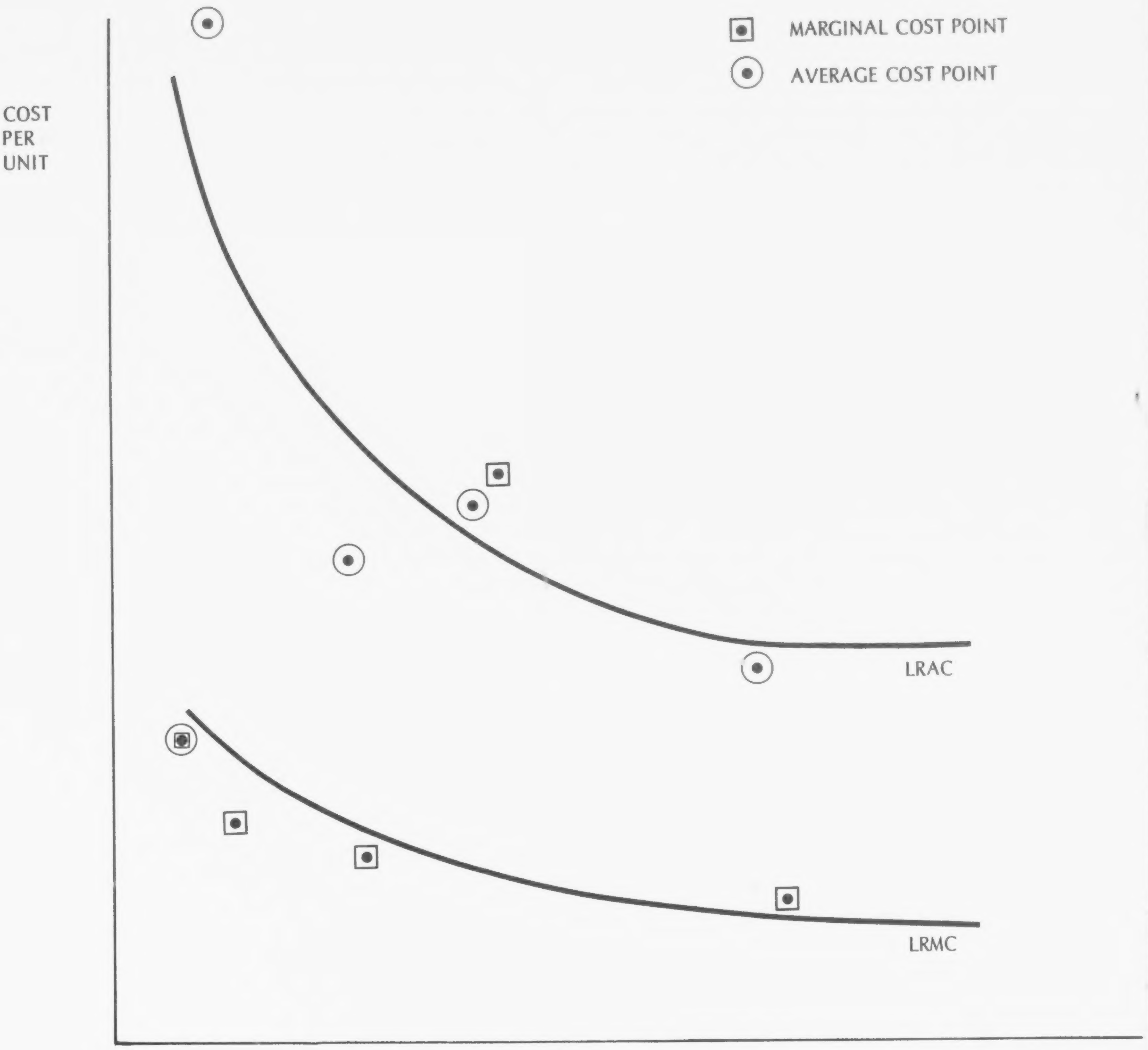

Figure 1

LONG-RUN AVERAGE AND MARGINAL COSTS

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3) Financial Analysis.

Due to the typically large sums of money involved, a financial analysis should be required for all public sector projects. The purpose of such an analysis is two-fold. First, by means of an accurate financial analysis, it is possible to ascertain whether the returns from any program warrant the expenditures required to carry it out. Second, the financial analysis will permit at least rough comparison between the net returns from the AVTS program and other potential public sector projects.[2] Such a comparison could result in a ranking of projects on the basis of net return or at least suggest the order of magnitude of any loss that will be borne as a result of choosing a project with a lower net return over one with a larger net return.

Two methods of financial analysis of public sector projects are currently in extensive use. These are benefit cost analysis and internal rate of return analysis.[3] The purpose of this section is to estimate the public sector costs per unit time to be used along with benefit and private cost data in deriving the benefit cost ratio and internal rate of return of the Tennessee AVTS program.

It is assumed that the capital expenditures of the program are financed by means of a state bond issued in 1963 and amortized over a twenty-five year period. The purpose of this assumption, of course, is to allocate the capital costs of the program over the useful life of structures and equipment. Obsolescence is somewhat arbitrarily assumed to occur after twenty-five years. It is further assumed that no depreciation account is set up. A discount rate of four percent is assumed to accurately reflect the cost of capital to state governments during the study period. Finally, it is assumed that all operating costs are financed by means of current tax revenues.

Given these assumptions, the total initial capital investment to be financed is calculated in table 5. Total expenditures on plant and equipment for each year between 1963 and 1968 have been discounted back to 1963. This procedure yields the amount that the state must finance by means of issuing bonds. Specifically, a twenty-five year four percent bond approximately 16.1 million dollars is assumed to have been issued in 1963. The annual outlay necessary to retire this bond on an amortized basis is $1.1 million.[4] This amount plus yearly operating expenditure represents the hypothetical allocated cost per year of the AVTS Program to the State of Tennessee. In table 6, allocated cost per year is discounted at four percent back to 1963. The sum of the present values of allocated cost is $12.4 million which when divided by the 8.2 million hours of instruction the program produced between 1963 and 1968 yields a cost to the state per hour of instruction of one dollar and fifty-two cents. Table 7 indicates the public cost of the program under various assumptions regarding the time period of analysis. One six-hour day of instruction costs $9.12. A five-day week costs $45.60. Yearly and monthly cost estimates are presented on the basis of a fifty-two and fifty-week year (in parentheses). The cost per fifty-week year is $2280.00.

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[2] A complete analysis would also consider private sector alternatives.

[3] See, for example, Otto Eckstein, Water Resources Development: The Economics of Project Evaluation, Cambridge, Mass., Harvard University Press, 1958; Roland N. McKean, Efficiency in Government Through Systems Analysis with Emphasis on Water Resource Projects, New York, Wiley and Sons, 1958.

[4] The exact amount is $1,133,263.37.

Table 5

PRESENT VALUE OF CAPITAL OUTLAY FOR PLANT AND EQUIPMENT 1963-68: TENNESSEE AVTS PROGRAM

Year	Expenditures on Physical Plant	Expenditures on Equipment	Total Expenditures on Plant and Equipment	Present Value of Total Expenditure on Plant and Equipment (r=.04)
1963-64	316,581.91	2,464.05	319,045.96	319,045.96
1964-65	3,067,676.03	3,347.68	3,071,023.71	2,955,324.81
1965-66	3,180,780.38	5,157.53	3,185,937.91	2,946,992.51
1966-67	5,528,922.06	10,728.35	5,539,650.41	4,924,749.21
1967-68	5,843,977.93	23,860.22	5,843,977.33	4,996,601.13
Totals	17,937,938.31	45,557.83	17,983,496.14	16,141,713.62

Source: Computed from data provided by: Division of Vocational Education, Department of Education, State of Tennessee.

Table 6

COMPUTATION OF TOTAL COST PER HOUR OF INSTRUCTION
TENNESSEE AVTS PROGRAM
(Includes capital costs of about 5 million)

Year	Allocated Cost	Present Value of Allocated Cost (r = .04)	Hours of Instruction (Includes full-time and part-time students)	Cost per Hour of Instruction
1963-64	1,326,557.61	1,326,557.61	322,319	--
1964-65	1,850,907.76	1,779,721.85	517,226	--
1965-66	2,778,383.67	2,568,782.41	1,419,926	--
1966-67	3,405,906.18	3,036,740.59	2,207,197	--
1967-68	4,356,485.45	3,723,923.76	3,635,922	--
Totals	13,718,240.67	12,435,726.22	8,156,590	1.52

Table 7

COST PER HOUR, DAY, WEEK, MONTH, & YEAR OF INSTRUCTION.
TENNESSEE AVTS PROGRAM

Cost Per Hour of Instruction	Cost Per Day of Instruction	Cost Per Week of Instruction	Cost Per Month of Instruction	Cost Per Year of Instruction
1.52	9.12	45.60	197.60 (190.00)	2,371.20 (2,280.00)

4) Use of Public Cost Estimates.

For a benefit cost analysis any entry in table 7 may be used depending on the time period of the analysis. If the time period is assumed to be a year, for example, \$2280 plus the private costs of the program would form the denominator of the benefit cost ratio.

The equation defining the internal rate of return, r, is,

$$K = \sum_{t=1}^{T} \frac{B_t - O_t}{(1+r)^t} \qquad (1)$$

where K is the initial investment, B_t is annual benefits, O_t is operating costs, and t is time. Rewriting equation (1) to explicitly take account of public and private benefits and costs results in,

$$K^a + K^p = \sum_{t=1}^{T} \frac{(B_t{}^a + B_t{}^p) - (O_t{}^a + O_t{}^p)}{(1+r)^t} \qquad (2)$$

where a and p stand for the private and public sector, respectively. This report provides data on K_p and $O_t{}^p$ in equation (2). K^p is equal to 16.1 million dollars and is found in table 5. $O_t{}^p$ is found in column two of table 3 under the heading of operating cost.

Most financial analyses of public sector investment projects compute both the internal rate of return and the benefit-cost ratio. The use of both criteria is suggested by the current debate in the literature surrounding the uniqueness of either method, particularly when a ranking of projects is desired.[5] A dual analysis may also be desirable due to the differences in the implied constraints and society's choice between present and future consumption underlying the two forms of analysis.[6] Finally, complementing a high benefit-cost ratio with an attractive internal rate of return might help remove a measure of the uncertainty surrounding the former, due to the controversy over the proper social rate of discount.[7]

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[5] On the other hand, both criteria yield the same cut-off point regarding unprofitable projects. See Eckstein, op. cit., p. 57. Also J. Hirshliefer, "On the Theory of Optimal Investment Decisions," Journal of Political Economy (August 1958), pp. 329-352.

[6] For a discussion, see David W. Rasmussen, Benefit Cost Versus Rate of Return: An Analysis of Investment Criteria, St. Louis, Missouri, Washington University, Economics Department Working Paper CWR 10, October 1966.

[7] For example, this report chose 4% mainly because this was the approximate average interest rate on state bonds during the study period. However, although this rate may accurately reflect the cost of money to a state government at the time, it is not clear that it accurately reflects the cost to society of diverting resources from other public and private uses. See Otto Eckstein and John V. Krutilla, Multiple Purpose River Development: Studies in Applied Economic Analysis, Baltimore, Md., Johns Hopkins Press, 1958, Chapter 4; and Jack Ochs, The Appropriate Set of Discount Rates for Public Investments, unpublished doctoral dissertation, Indiana University, 1966.

APPENDIX B

AVTS Data Form, Form A 133

Questionnaire, Form B 134

Social Security Card, Form C 136

High School Matching Form, Form D 137

Letter Accompanying Questionnaire, Form E . 139

Follow-up Letter, Form F 140

Follow-up Cards, Form G 141

FORM A

1. Name of School ____

2. Name ____
(Last Name) (First Name) (Middle Name)

3. Address (Last Known) ____
(Street)

____
(City) (State)

4. Age ____________

5. Sex ____________

6. Marital Status ____________

7. Date of Birth ____
(Month) (Day) (Year)

8. Parent or Guardian ____

9. Address of Parent or Guardian ____

____

10. Hours of Instruction Received (Total) ____

11. Last Program in which Enrolled ____

12. GATB Scores

G____ V____ H____ S____ P____ Q____ K____ F____ M____

13. Performance in School

Above Average ________ Average ________ Below Average ________

14. Last Known Mailing Address ____

15. Employer (Last Known) ____

16. Reason for Leaving ____

17. Race ____

18. Date of Entry ____

19. Date of Exit ____

20. Last School Attended ____

21. Number of Years Completed ____

22. Telephone Number ____

FORM B

AT THE END OF THIS QUESTIONNAIRE THERE IS SPACE
FOR YOUR COMMENTS AND OPINIONS

1. Name ______________________________
First Last

2. Present Address ______________________________
Street or Route City State

3. Do you now have a job? ______ no ______ yes Are you a Veteran? ______ no ______ yes

IF YOU DID NOT HAVE ANY JOB DURING 1968, SKIP QUESTIONS
4 and 5 and go to question 6

4. Please answer these questions about your present or most recent job.

a. For whom do you work? ______________________________
(name of company, business or organization)

b. What kind of business or industry is your employer in? ______________________________
(such as: shoe factory, grocery store, farm, paper mill, bank, etc.)

c. What kind of work are you doing? ______________________________
(such as: welding, truck driving, selling, farming, bookkeeping, assembling, machine operator, etc.)

d. Are you self-employed? ______ no ______ yes If yes, how much do you earn (after business expenses) on the average per month? $ ______ per month

e. If you work for someone else, how much do you earn on the average before any deductions, counting overtime and incentive pay if you usually get it? $ ______ per ______ hour, week or month

f. Were you out of work at any time during 1968? ______ no ______ yes If yes, how many weeks were you out of work? ______ weeks Why? ______________________________ (Reason)

5. Have you done other kinds of work during 1968, different from your answer to Question 4(c)?

____ no ____ yes If yes, what other kinds of work have you done? ____________ (such as: welding, ____________ truck driver, selling, farming, bookkeeping, assembling, machine operator, etc.)

IF YOU ANSWERED QUESTIONS 4 and 5, SKIP 6 and go to 7

6. Why were you out of work during 1968? ____________

7. What is your present marital status? ____ Married ____ Single ____ Other

IF SINGLE, PLEASE GO TO QUESTION 8. IF MARRIED OR OTHER, PLEASE ANSWER a and b BELOW.

a. In what year were you married? ____ Year

b. If you have children at home, give year of birth of oldest child ____ Year

8. Have you ever taken any training or education programs for at least six weeks not counting high school? ____ No ____ Yes

(such as: college, junior college, technical institute, business college, barber college, apprenticeship, area vocational-technical school, company training, Armed Forces school, correspondence schools, etc.)

Kind of Program	Began (Month & Year)	Ended (Month & Year)

COMMENTS AND OPINIONS

(include whether or not you have been able to find work that suits your abilities and training, or anything else you want to tell us about your answers.)

____

____

FORM C

SOCIAL SECURITY CARD

Please send a statement of the amount of quarterly earnings in my social security account to:

OCCUPATIONAL RESEARCH
THE UNIVERSITY OF TENNESSEE
KNOXVILLE

___ __ ____
Social Security No.

____________ ____________________________
Date Signature

FORM D

High School
County
High School Counselor and Phone No.
Area School Counselor

	Experimental Subject	Control #1	Control #2	Control #3	Control #4
Name					
Date of Birth					
Last Known Address					
Address of Parent or Guardian					
Name of Parent or Guardian					
Father's Occupation					
Sex					
Race					
Year of Graduation					
Grade Point Average					
I.Q. Score Test_______					
Rank in Class of_______					
Type of Program (academic, vocational or general)					
Comments					

	Control #5	Control #6	Control #7	Control #8	Control #9
Name					
Date of Birth					
Last Known Address					
Address of Parent or Guardian					
Name of Parent or Guardian					
Father's Occupation					
Sex					
Race					
Year of Graduation					
Grade Point Average					
I.Q. Score Test ______					
Rank in Class of ______					
Type of Program (academic, vocational or general)					
Comments					

FORM E

THE UNIVERSITY OF TENNESSEE
COLLEGE OF EDUCATION
KNOXVILLE, TENNESSEE 37916

OCCUPATIONAL
RESEARCH AND DEVELOPMENT
COORDINATING UNIT
909 MOUNTCASTLE STREET

The University of Tennessee is making a survey for the State Area Vocational-Technical Schools. We are writing former students to find out what they are doing since they left school. We need your help to study the value of the training you received.

The information you send will not be seen by anyone else. It will be used to tell us the kinds of jobs former students now have and the average wages for the jobs, but no names will be given anywhere in the report.

Since exact wages in past years are so hard to remember, we would like to get this information from your social security record. We cannot do this unless you sign a social security card. Any information we receive from your social security record will be held in absolute confidence, just like the information you are giving us yourself.

Please fill out the questionnaire, sign the social security card, and mail both of them in the enclosed stamped envelope right away. The enclosed fifty cents is for your trouble and time. Thank you very much for your help.

Sincerely yours,

F. Ragan Lewis

F. Ragan Lewis
Professor

FRL:trm

Enclosure

FORM F

THE UNIVERSITY OF TENNESSEE
COLLEGE OF EDUCATION
KNOXVILLE, TENNESSEE 37916

OCCUPATIONAL
RESEARCH AND DEVELOPMENT
COORDINATING UNIT
909 MOUNTCASTLE STREET

A short time ago you received a questionnaire concerning what you are doing since you left the Area Vocational-Technical School. Since you may have lost the first questionnaire, we are enclosing another.

We have gone to great expense in both money and time and hope that you will complete and return the questionnaire to us. We realize that not everyone will be able to cooperate, but hope that every former student of the Area Vocational-Technical Schools will complete and return the questionnaire.

Please fill out the questionnaire, sign the Social Security Card and return it to us. PLEASE! We need your help!

Sincerely yours,

F. Ragan Lewis

F. Ragan Lewis
Professor

FRL:trm

Enclosure

FORM G

A REMINDER

A short time ago you received an Employment Questionnaire from the University of Tennessee. We have not yet received your questionnaire, but hope you will complete and return it to us today. The study cannot be completed without your HELP.

Occupational Research
University of Tennessee

A short time ago you receive a second Employment Questionnaire from the University of Tennessee.

If you cannot or will not cooperate, please state the reason under the "REMARKS" section of the Questionnaire and return it to us.

F. Ragan Lewis

F. Ragan Lewis
Professor

On behalf of the University of Tennessee I wish to thank you very much for participating in our Employment Study.

We hope to be back in touch with you again in about three years to find out about any change in your work.

Again, THANKS,

F. Ragan Lewis

F. Ragan Lewis
Professor

001-00139
02-71-001M

Edited and Published by
Vocational Curriculum Laboratory
Box 1114
Murfreesboro, Tennessee 37130

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